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THESIS

AUTOMATED TOOL FOR ACQUISITION PROGRAM MANAGEMENT STUDENTS (ATAPMS)

by

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March 2000

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This thesis explores the top-level requirements for an Automated Tool for Acquisition Program Management Students (ATAPMS) that is designed to enhance training and education in the acquisition management field. The Department of Defense (DoD) has identified the education and training of the acquisition workforce as a strategy to help make the acquisition system more effective and efficient. As a result, the DoD established the Defense Acquisition University (DAU) to provide the required education and training. More recently, Executive Order 13111 and the Defense Reform Initiative have presented a mandate for the DoD to find ways to use technology to further this strategy.

Currently, the consortium schools of the DAU are using emerging technologies to increase access to their courses. However, the DAU curricula lack automated acquisition management training programs that allow instructors to qualitatively assess students' work.

This thesis recommends a set of top-level requirements for an automated program that are in compliance with the Advanced Distance Learning Initiative. It then illustrates through a prototype module, using a commercial authoring tool, how an ATAPMS can assist the DAU instructors teach the critical aspects of Acquisition Program Management.

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AUTOMATED TOOL FOR ACQUISITION PROGRAM MANAGEMENT STUDENTS (ATAPMS)

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Submitted in partial fulfillment of the
requirements for the degree of

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ABSTRACT

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I. INTRODUCTION

A. AREA OF RESEARCH

The primary focus of this research is to explore the top-level design requirements for an automated education and training program for acquisition management topics. The purpose of this automated program is to enhance the training and education in the acquisition management field. This thesis recommends a set of top-level requirements and then illustrates, by developing a prototype, how an automated program can assist the Defense Acquisition University (DAU) consortium instructors teach the critical aspects of Acquisition Program Management.

B. BACKGROUND

The Department of Defense includes improvement to education and training as one of the goals of Acquisition Reform [Ref. 1]. Additionally, Executive Order 13111 [Ref. 2] directs federal agencies to take certain steps to enhance an employee's training opportunities through the use of technology. The DAU, through its 14 consortium schools which include the Naval Postgraduate School (NPS), provides education and training for acquisition professionals throughout the Department of Defense. Currently, the DAU is using emerging technologies to increase access to its courses. However, the DAU curricula lack acquisition management training programs that are dynamic or that allow instructors to qualitatively assess students' work.

C. RESEARCH QUESTIONS

The primary research question addressed in this thesis is:

-What are the top-level requirements for developing an automated program that assists the DAU instructors with teaching the critical aspects of Acquisition Program Management?

Subsidiary research questions are:

-What are the existing automated training programs for Acquisition Program Management students?

-What are the critical aspects of Acquisition Program Management?

-To what extent are they adequately presented in the existing automated training tools?

-What are the needs of the DAU consortium instructors that can be incorporated in an automated program?

-How may these design requirements be implemented in a prototype?

D. METHODS

The first objective of this research is to document the critical aspects of Acquisition Program Management and provide an overview of the existing automated training tools used to teach them. This is accomplished through personal interviews and a literature review of sources including:

-Staff members and instructors at several of the Defense Acquisition University consortium schools, including the Naval Postgraduate School.

-References and publications available at the Naval Postgraduate School library.

-Internet websites (DoD, academic, and commercial).

The second objective is determining the top-level requirements for developing an automated program that assists the DAU consortium instructors with teaching the critical

aspects of Acquisition Program Management. This is also accomplished through personal interviews and a literature review of sources including:

-Instructors at the Naval Postgraduate School.

-Internet websites (DoD, academic, and commercial).

After developing these top-level requirements, this thesis illustrates them using a prototype of a course module.

E. ORGANIZATION

Chapter II (Background) explores the DoD's efforts to improve the acquisition system though the proper training and education of the acquisition workforce. It also details the latest developments in expanding the reach and reducing the cost of providing education and training through the development of standards and the use of technology. Finally, the chapter identifies the need for an application that possess a feedback mechanism that enables an instructor to assess a user's opinion or overall understanding of concepts.

Chapter III (Program Management) provides an overview of program management using an industry model to present the related functional disciplines that a program manager is expected to integrate during the program life cycle. It also introduces the concept of an "Automated Tool for Acquisition Program Management Students" (ATAPMS) to assist the DAU instructors.

Chapter IV (Structure and Content Requirements) develops the structure, strategies and topics for an ATAPMS tailored to the Naval Postgraduate School instructors' needs.

Chapter V (Design of the Program Management Training Tool) presents one possible approach to devising an ATAPMS application that meets the requirements specified in Chapter Four. The chapter enumerates strategies for acquiring the software required to support an ATAPMS application and then uses one of those strategies for demonstrating the construction of a notional module.

Chapter VI (Conclusions and Recommendations) summarizes the findings of the research and presents recommendations for further research and study.

F. BENEFITS OF STUDY

This study provides the requirements and a design for an automated tool that once implemented, can be used to enhance the Naval Postgraduate School's capability to provide instruction on Acquisition Program Management. This application is also relevant to the Defense Acquisition University consortium schools because it allows the host institution to offer a portable, comprehensive, and thoroughly relevant automated program through which students can demonstrate their knowledge on the fundamental aspects of Acquisition Program Management. The program also adheres to the precepts of the Defense Reform Initiative, the Advanced Distance Learning Initiative, and Executive Order 13111, "Using Technology to Improve Training Opportunities."

II. BACKGROUND

A. INTRODUCTION

This chapter illustrates the need to execute the Defense Acquisition mission as effectively and efficiently as possible. It also explores the Department of Defense's (DoD) efforts to improve the acquisition system though the proper training and education of the acquisition workforce. Finally, this chapter details the latest developments in expanding the reach and reducing the cost of providing education and training through the development of standards and the use of technology.

B. MOTIVATION FOR BETTER MANAGEMENT

The Defense Acquisition mission is extensive and complex and requires a significant amount of the DoD's resources. The scope of this acquisition mission covers:

> The conceptualization, initiation, design, development, test, contracting, production, fielding, deployment, and logistic support, modification, and disposal of weapon and other systems, supplies, or services (including construction) to satisfy DoD needs, intended for use in or in support of military missions. [Ref. 3]

Every year the DoD spends approximately $80 billion in Research, Development, Test and Evaluation (RDT&E) and Procurement appropriated funds for these acquisition-related expenses, or approximately 30% of the overall DoD annual budget [Ref. 4: p. 6].

Over the last 15 years, the DoD has experienced a trend of shrinking budgets (Figure 2-1)[Ref. 4: p. 89]. While fiscal year 2000 to fiscal year 2004 are expected to provide a slight reversal of the downward trend, the DoD budget as an overall percentage of the Federal budget remains historically low (Figure 2-2) [Ref. 5]. With such a significant percentage of DoD capital expended in the area of acquisition, especially in

view of the current budgetary trend, there is a need to be as effective and efficient as possible when acquiring the required goods and services.

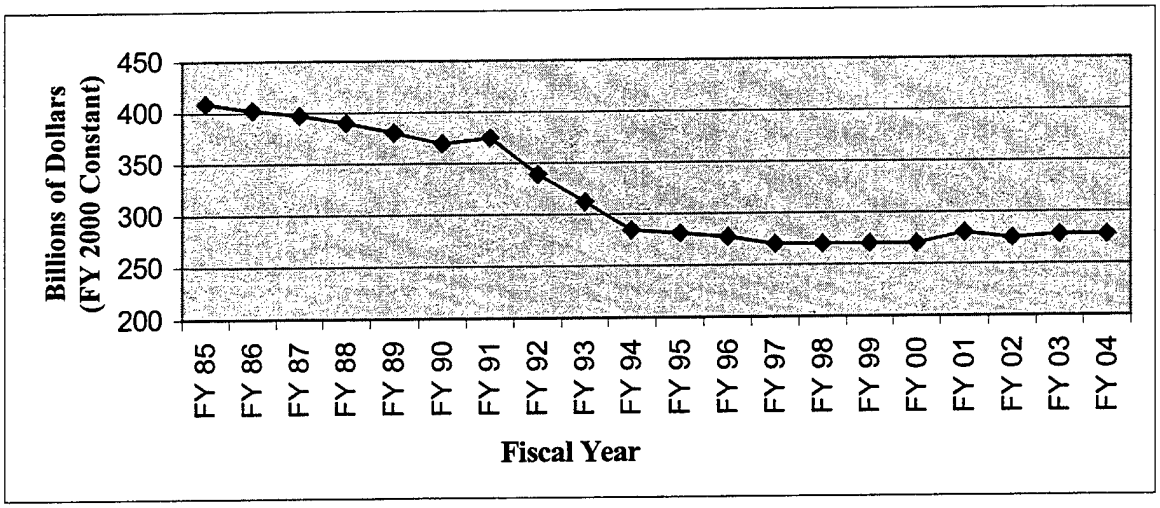

Figure 2-1. DoD Total Obligation Authority.

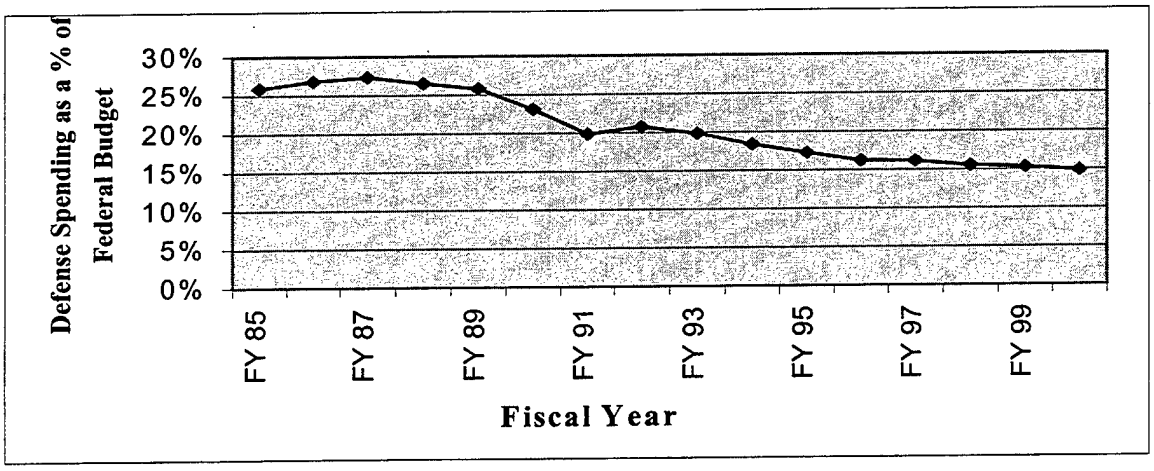

Figure 2-2. Defense Outlay as a Percentage of the Overall Federal Budget.

C. DAWIA AND DAU

One method the DoD uses to improve the overall acquisition system is to improve the training and education of the people who work in the acquisition field. The standards and infrastructure used for the training and education provided today were established in

1990 through the Defense Acquisition Workforce Improvement Act (DAWIA), Public Law 101-501, Title XII. The law directed the following [Ref. 6: p. 1638]:

-Establishment of policies and procedures for acquisition personnel education and training programs, including intern, cooperative education, and scholarship programs.
-Authorization of special pay for acquisition officers in certain critical positions, and repayment of student loans to facilitate recruitment and retention of acquisition personnel.
-Revision of policies and procedures for the recruitment, training, and career development of military and civilian defense acquisition personnel.
-Establishment of acquisition corps for each military department and for other defense agencies.
-Establishment of the Defense Acquisition University.

The DoD is implementing the law through the adoption of standards detailed in DoD manual 5000.52-M "Acquisition Career Development Program" released in November 22, 1995. The manual "provides information, guidance, and requirements for improving the management and professionalism of the acquisition workforce" [Ref. 7: p. 14].

As directed by the DAWIA, the DoD created the Defense Acquisition University (DAU) in 1990. The DAU is responsible for coordinating the provision of the mandatory, assignment specific, and continuing education courses that meet the standards prescribed by DoD 5000.52-M for military and civilian personnel serving in several acquisition career fields. The DAU's mission is to educate and train professionals for effective service in the Defense acquisition system. [Ref. 8]

The DAU was established as a consortium of 12 DoD educational and training institutions located throughout the country. These members provide more than 85 acquisition courses to the approximate 106,000 entry, intermediate, and senior level

civilian and uniformed personnel [Ref. 9: p. 3] to allow them to attain certification in one or more of the following 11 defense acquisition career fields [Ref. 9: p. 27]:

-Acquisition Logistics
-Auditing
-Business, Cost Estimating, and Financial Management
-Communications-Computer Systems
-Contracting
-Industrial and /or Contract Property Management
-Manufacturing and Production
-Program Management
-Purchasing
-Systems Planning, Research, Development and Engineering
-Test and Evaluation

As of 1999, the consortium members providing the training and education to the acquisition workforce were [Ref. 9: p. 4]:

-Air Force Institute of Technology (AFIT)
-Lackland Training Facility
-Army Logistics Management College (ALMC)
-Defense Logistics Agency Center for Training, Education and Development (formerly DCPSO)
-Defense Contract Audit Institute (DCAI)
-Defense Systems Management College (DSMC)
-Information Resource Management College (IRMC)
-Industrial College of the Armed Forces (ICAF)
-Naval Center for Acquisition Training (NCAT)
-Naval Postgraduate School (NPS)
-Naval Facilities Contracting Training Center (NFCTC)
-Naval Warfare Assessment Division (NWAD)

D. MANDATES FOR TECHNOLOGY

Although today's acquisition training and education infrastructure was originally shaped by the passage of DAWIA, that infrastructure is continuously influenced by developments affecting education and training within the Federal government. One of these developments is the drive to leverage technology as a way to reduce cost and increase the availability of training and education opportunities.

1. Defense Reform Initiative

The Secretary of Defense introduced the Defense Reform Initiative (DRI) on November 10th, 1997 to improve business practices in the Department of Defense. The DRI is described by the DoD as an effort to coordinate several internal and external ongoing reform initiatives and to bring the Department "in tune with the times". The Secretary's intent was to use the DRI as a mechanism to identify savings and migrate resources to support modernization accounts. [Ref. 1]

a) DRI Goals

The DRI originally focused on initiatives in four main areas, and eventually expanded to include nine additional elements. The initial areas were [Ref. 1]:

-Reengineer: Adopt modern business practices to achieve world-class standards of performance;
-Consolidate: Streamline organizations to remove redundancy and maximize synergy;
-Compete: Apply market mechanisms to improve quality, reduce costs, and respond to customer needs;
-Streamline: Reduce excess support structures to free resources and focus on core competencies.

The following nine elements are the expanded areas, one of which includes Acquisition [Ref. 1]:

-Adopting Best Business Practices
-Quality of Life
-Organizational Streamlining
-Competition
-Infrastructure
-Logistics
-Cyberspace
-Homeland Defense
-Acquisition

b) Acquisition Element

Acquisition Reform supports the DoD's efforts to provide the warfighter with products that "work better, cost less, and are obtained from a globally competitive national industry base" [Ref. 1]. The major goals of the acquisition reform effort include [Ref. 1]:

> -Fostering Partnership: Modernizing defense; partnering with communities; decreasing paper transactions; and reducing toxic pollution.
> -Internal Reinvention: Streamlining our workforce; providing effective cost accounting; reducing excess inventory; and minimizing weapons cost growth.
> -Delivering Great Service: New weapons in less time; better logistic supply services; simplifying buying of goods and services; and educating and training the defense acquisition workforce.

The principal controlling documents for Acquisition programs are DoD Directive 5000.1; "Defense Acquisition", and DoD Regulation 5000.2-R; "Mandatory Procedures for Major Defense Acquisition Programs (MDAPs) and Major Automated Information Systems (MAISs) Acquisition Programs." DoDD 5000.1 describes broad management principles that are applicable to all DoD acquisition programs. DoD 5000.2-R establishes mandatory procedures for MDAPs and MAISs. [Ref. 10]

As part of the acquisition reform effort, the DoD issued an update to the 5000 series Directive and Regulation. This update defines an acquisition environment that makes DoD "the smartest, most responsive buyer of the best goods and services that meet our warfighters' needs, at the best dollar value over the life of the product to help meet these efforts" [Ref. 10]. The updated documents contained six major themes that support the acquisition reform effort [Ref. 10]:

-Teamwork: We must work together as a team to build successful programs, identify problems early, and maintain a cooperative spirit of resolution, thereby providing programs the highest opportunity for success.
-Tailoring: Milestone Decision Authorities (MDA should strive to tailor most aspects of the acquisition process, including program documentation, acquisition phases, and the timing, scope, and level of decision reviews.
-Empowerment: Program managers do not have to ask permission to take actions that are otherwise permitted by law and are within the scope of their charters. The Department has long relied on volumes of guidance and regulation, prescribing every detail of both process and documentation. DoD has also had a habit of dealing with industry through a rigid system of military specifications. DoDD 5000.1 and DoD 5000.2-R reflect current efforts to empower our people and our vendors to do the best they can.
-Cost as an Independent Variable (CAIV): The acquisition process described in DoDD 5000.1 and DoD 5000.2-R must consider both performance requirements and fiscal constraints. Accordingly, cost must also be an independent variable in programmatic decisions, with responsible cost objectives set for each program phase.
-Commercial Products: Historically, DoD has relied on segments of the U.S. technology and industrial base principally dedicated to supporting DoD requirements...Acquisition of commercial items, components, processes, and practices provides rapid and affordable application of these technologies to validated, DoD mission needs.
-Best Practices: DoD 5000.2-R describes a simplified and flexible management process, modeled on sound business practices. Acquisitions of the future must take into account customary commercial practices in developing acquisition strategies and contracting arrangements.

"Educating and training the workforce" is a subset to one of the major goals of the Acquisition element. In an effort to support the acquisition reform education and training goal, the DAU is planning to use emerging technologies to increase access to its courses. Further, in its "Implementation Plan for Technology Based Education and Training" document, the DAU recognizes that these courses need to be "designed and delivered so they are updated quickly and inexpensively and their shelf life can be extended." [Ref. 11]

Currently, the DAU is working toward these efforts and taking advantage of new distributed learning technology to modernize its curriculum. In 1997, 10% of the DAU's courses were modernized and delivered by distributed learning technologies. The goal is

to complete modernization of all of its courses through technology enhancements by 2003. [Ref. 12]

2. Executive Order 13111

President Clinton signed Executive Order (EO) 13111, "Using Technology to Improve Training Opportunities", on 12 January 1999. This EO directs federal agencies to take certain steps to enhance an employee's training opportunities through the use of technology. Specifically, the Order states "A coordinated federal effort is needed to provide flexible training opportunities to employees and to explore how federal training programs, initiatives, and policies can better support lifelong learning through the use of learning technology." To assist with this goal, the EO established the President's Task Force on federal training technology and created an advisory committee on expanding training opportunities. [Ref. 2]

3. Advanced Distance Learning Initiative

The DoD launched the Advanced Distance Learning (ADL) Initiative in November of 1997. The ADL is an effort by the DoD to identify more efficient and effective ways to educate and train the DoD personnel through the development of advanced distributed learning technologies. The purpose of the ADL initiative is to "ensure access to high-quality education and training materials that can be tailored to individual learner needs and can be made available whenever and wherever they are required." [Ref. 13]

In his November 1998 memorandum "Developing and Implementing the DoD Advanced Distributed Learning (ADL) Initiative", the Deputy Secretary of Defense directed the Under Secretary of Defense for Personnel and Readiness (USD(P&R)) to

lead the ADL Initiative and to work with the Services, Joint Staff, and other DoD components in developing and implementing ADL technologies across the DoD [Ref. 14]. Through this initiative, the DoD seeks to accelerate large-scale development of "dynamic and cost effective learning software...in order to meet the education and training needs of the military and the nation's workforce in the 21st century." [Ref. 13]

a) Lack of Standards

This initiative addresses the problem created by a lack of standards within the education software industry. Developers of online learning resources have many different software tools to choose from to create their courses. Prior to the ADL, however, there was no common learning management software reference model. As a result, the available computer-based training authoring tools have historically been developed on a proprietary, company by company basis. This scenario results in high development costs and limits the reuse potential for already developed software. [Ref. 15]

b) Instructional Management Systems Project

To help alleviate the commonality problem within the DoD and accomplish the previously stated DoD objectives, the DoD has teamed with the Instructional Management System (IMS) Project. The IMS is a consortium of government organizations, over 1,600 colleges and universities, and 150 corporations [Ref. 13]. The IMS project is an effort to develop next-generation open architecture for online learning software.

Overall, the IMS attempts to address three obstacles for providing effective online materials and learning environments [Ref. 16]:

-Lack of standards for locating and operating interactive platform-independent materials
-Lack of support for the collaborative and dynamic nature of learning
-Lack of incentives and structure for developing and sharing content

By teaming with the IMS consortium, the DoD is helping to formulate industry – wide voluntary learning specification guidelines that will make learning software interoperable, reusable, and accessible through the Internet [Ref. 15]. The IMS technical specifications will provide the general guidelines and requirements developers must write to for creating interoperable content and management systems [Ref. 17].

The IMS efforts are centered on specifications in four areas [Ref. 17]:

-Meta-data: Descriptive labels can be used to index learning resources to make them easier to find and use. Such labels are "data about data" and are referred to as "meta-data." An example of meta-data is the label on a can of soup, which describes the can's ingredients, weight, cost, and so forth...A meta-data specification makes the process of finding and using a resource more efficient by providing a structure of defined elements that describe, or catalog, the learning resource, along with requirements about how the elements are to be used and represented. [Ref. 18]

-Packaging and Run-time services: This area focuses on specifications for searching, digital packaging, and modularizing content with the goal that any content can run on any learning server. Resources can be drawn from any developer and potentially reused in different learning activities. [Ref. 19]

-Profiles: User profiles are mobile, user-controlled collections of personal and educational data including personal information, performance information, and preference information. This data represents a rich resource that a user can draw on to facilitate, customize, and manage his or her learning experience(s). [Ref. 19]

-Enterprise integration: The IMS Enterprise Information Model describes data structures that are used to provide interoperability of Internet-based Instructional Management systems with other Enterprise systems used to support the operations of an organization. The objective of the IMS Enterprise Information Model is to define a standardized set of structures that can be used to exchange data between different systems. These structures provide the basis for standardized data bindings that allow

software developers and implementers to create Instructional Management processes that interoperate across systems developed independently by various software developers. [Ref. 20]

E. CURRENT METHODS USED TO ASSIST ACQUISITION TRAINING

The DAU is using technology-based education and training methods to maintain pace with the reforms in the acquisition process. While the DAU has successfully converted several of its courses to a technology-based delivery, the methods for presenting the acquisition related training and education are still as diverse as the consortium members providing it [Ref. 9: p i]. A survey by the author of the delivery medium used by the consortium members revealed several methods of course presentation including traditional classroom, mobile teaching, video teleconferencing, automated programs, and the Internet.

1. Classroom

Classroom training is the traditional method of providing instruction. Students typically travel to the institution's location from several dispersed areas to receive training and instruction.

2. Mobile Teaching

One of the non-traditional methods of providing instruction to the students is mobile teaching. Using the mobile teaching concept, the instructor travels to the student's location instead of the students traveling to the instructor's location.

3. Video Teleconference Courses

Several consortium members conduct courses using video teleconference technology as the medium. The typical scenario consists of an instructor co-located at one

location with a small contingency of students, while students communicate with the instructor via real-time voice and video from remote locations.

4. Non-interactive Automated Courses

Some of the consortium members offer course material in a non-interactive automated format. One member provides a laptop computer that has course material preloaded. The course material is presented in a dynamic, hypertext-linked environment. This program is not interactive, however, as its purpose is to present information instead of soliciting information from the user.

The NPS uses a program called Systems Acquisition For Executives (SAFE) that works on a slightly different premise. Instead of automated course material, SAFE users only have access to a workbook. The instructor maintains access to the actual SAFE program and provides the students with the results of the SAFE program simulations.

SAFE is a computer-assisted exercise that allows the user to influence the outcome of the acquisition program in the scenario based on decisions concerning the cost, schedule, and performance parameters. The scenario and worksheets are contained in a manual and the students use this information to provide the instructor with their cost, schedule, and performance decisions at discrete points through the exercise. When the instructor enters the students' data into the automated program, the SAFE program simulates an outcome and then generates a response indicating the updated status of each student's program. The students begin another session of decision-making based on the updated status of their program and the next set of alternatives presented by the scenario in the workbook.

5. Interactive Internet Courses

The DAU provides several courses using the Internet or a compact disk as the medium. Each course contains several lessons that are further organized by topics. These courses are self-paced, interactive modules. They contain hypertext-links that allow students to navigate through instructional material and case scenarios. The interactive multi-media capable modules require students to input information gleaned from the instructional text and case scenarios. The modules provide the user feedback based on the information entered. All of this information is viewed on the user's web browser. These courses typically have associated tests delivered in electronic format that students are required to pass before earning credit for completing the course.

F. CURRENT DEFICIENCIES

The intent of the Executive Order, the DRI, and the ADL initiative is clear: the DAU must leverage the advances of technology and incorporate automation and distance learning into the training and education of the acquisition workforce to highest degree possible.

Even though the DAU has a plan for achieving this objective and the number of interactive automated courses continue to grow, the current courses lack the ability to provide education and training on a qualitative basis. The responses from the interactive courses are predetermined and codified in the software. There is no interaction with a "subject matter expert" to review the student's input and provide a qualitative response for scenarios that have more than one correct answer. In essence, while courses do interact with the user, they do not possess a feedback mechanism to assess a user's opinion or overall understanding of concepts.

G. CHAPTER SUMMARY

Because the acquisition mission is broad and consumes a significant percentage of the DoD's resources, there is an unquestionable need to execute that mission in the most effective and efficient manner as possible. Accordingly, the DoD has identified the proper education and training of the acquisition workforce as a strategy to help improve the acquisition system. As directed by the DAWIA, the DOD established the DAU to provide this required education and training.

There is a current emphasis on leveraging the use of technology to broaden the accessibility and reduce the cost of providing the required education and training to the acquisition workforce. EO 13111 and the DRI provide a clear mandate for the DoD to find ways to use technology to further this goal. Additionally, the efforts that the DoD have undertaken in the ADL initiative will help provide the mechanism for the added reach and the decreased cost through the creation of industry-wide standards for educational software.

Even though the DAU is responding to this mandate and providing interactive distance learning courses, there is one type of course not yet offered. There are currently no automated courses that allow for qualitative assessments of a student's work.

The next chapter provides an overview of one of the critical acquisition career fields: program management. Because program management is a diverse field that integrates the other disciplines within acquisition, this thesis will use it as the subject of an example course in a subsequent chapter.

III. PROGRAM MANAGEMENT

A. INTRODUCTION

This chapter provides an overview of program management. The chapter uses a model borrowed from industry to present the related functional disciplines that a program manager is expected to integrate during the program life cycle. The disciplines presented in this chapter will be linked to their Defense Acquisition counterparts in the following chapter.

B. IMPORTANCE OF PROGRAM MANAGEMENT

Program management is listed as one of the 11 critical career fields within the acquisition system. Specifically, the DoD defines program management as [Ref. 21: p. 12]:

> The process whereby a single leader exercises centralized authority and responsibility for planning, organizing, staffing, controlling, and leading the combined efforts of participating/assigned civilian and military personnel and organizations, for the management of a specific defense acquisition program or programs, through development, production, deployment, operations, support, and disposal.

Program management is critical to the acquisition system because it provides a single point of contact who acts as an "integrator" of a complex system of "differing but related functional disciplines" [Ref. 21: p. 13]. These functional disciplines relate to areas such as business and financial management, logistics, systems engineering, software management, test and evaluation, manufacturing management and others [Ref. 21: p. 13]. To provide a more detailed understanding of program management, the remainder of this chapter is dedicated to presenting an overview of program management and its related functional disciplines.

C. PROGRAM MANAGEMENT OVERVIEW

Industry typically uses a program management model similar to that used in the DoD acquisition system. The contractor staff usually operates its program office to parallel the military office it is supporting on a defense project [Ref. 21: p. 14].

Because the industry and defense models of program management are similar, this chapter uses an industry model from Forsberg, Mooz, and Cotterman's textbook "Visualizing Project Management" as a reference to describe the "differing but related functional disciplines" that a program manager must integrate.

While the program management models are similar, the terminology is not always the same. The DoD uses the term "program manager" and industry commonly uses the term "project manager". Even though the two terms are synonymous [Ref. 21: p. 12], the remainder of this section uses the term "project manager" because that is the term used by the authors.

In their textbook, Forsberg, Mooz, and Cotterman divide the project management process into four essentials: Common Vocabulary, Teamwork, Project Cycle, and the Project Management Elements [Ref. 22: p. 27]. The first two components, Common Vocabulary and Teamwork, are characterized as perpetual properties. They are always present throughout the lifecycle of a project. The third component, Project Cycle, relates to sequentially occurring activities of a project. Finally, the Project Management Elements are described as situational and are applied on an as needed basis.

1. Common Vocabulary

A common vocabulary is the first perpetual property of projects. The authors contend that to succeed at project management, one must communicate using clearly

defined terms. Otherwise, vocabulary problems can lead to conflict and ultimately destroy teamwork. Therefore, a common vocabulary is necessary before you can develop teamwork.

This is true in part because problems occur when terms used in project management are confused with similar terms used in the context of other fields. An example given is the contractor who mistook the term "prototype" to mean an engineering model that could be based on commercially available parts instead of a model built to released drawings with production-worthy parts and processes [Ref. 22: p. 53].

The authors provide many reasons to demonstrate the need for a common vocabulary at the project level [Ref. 22: p. 27]:

-Most companies do not have a common vocabulary.
-Schools do not have, and consequently do not teach a common vocabulary.
-Words are used differently across projects, companies, and industries.
-Terminology manuals, when they exist, are often imprecise.
-There is little effort to fix the problem.

To alleviate this deficiency, the authors recommend a terminology manual for each project. A terminology manual, taking into consideration the terminology appropriate to the industry, company, and the specific project, is indispensable for mitigating the communication problems caused by a vocabulary breakdown.

2. Teamwork

Teamwork is the second perpetual property of projects. Without a commitment to teamwork, project activity is subject to seemingly chaotic activities. In fact, the DoD recognized this "essential" by including it as a major theme in the recent update to the 5000 series documents.

To help project managers achieve real teamwork; the authors provide five fundamentals of teamwork and the techniques for achieving them [Ref. 22: p. 31]:

a) Common Goals

The first step to building teamwork is to clearly define the group objectives. Managers need to outline the roles and responsibilities required by the team members to accomplish the objectives. Additionally, managers must ensure that team members can articulate these common goals and that they are committed to achieving them. [Ref. 22: p. 62]

b) Acknowledged Interdependency and Mutual Respect

When interdependencies are not acknowledged, there is no footing for teamwork. There is only the foundation for "well structured independent effort." [Ref. 22: p. 63] For interdependencies to be recognized, the team members need to accept, and respect, the roles that must be filled by each team member. The authors list the three steps to acknowledging interdependencies and establishing expectations as [Ref. 22: p. 63]:

-Defining the specific functions, tasks, and individual responsibilities.
-Developing an organizational structure and defining team interdependencies.
-Defining the scope of each team member.

These steps are not only recommended for use during the initial formation of the team, but also for the subsequent inclusion of new team members.

c) A Common Code of Conduct

The most commonly overlooked factor in teamwork, according to the authors, is a common code of conduct. Even though the obvious conduct issues are usually well documented by company and government policies, they still may not be well

known to all the team members. Gray areas are especially subject to misinterpretation and confusion. Compounding the problem, managers often assume that a code of conduct is implied and understood even if it has not be specifically defined and agreed to. The end result can be the destruction of teamwork through tension and separation among the team members.

The authors provide guidelines for a code of conduct. To be effective, a common code of conduct must [Ref. 22: p. 65]:

-Establish rules of behavior.
-Reach consensus on the definition of an ethical code of conduct.
-Document the most significant factors.

Managers therefore have a responsibility to review the issues to ensure that all team members are aware of the potential problems. Figure 3-1 illustrates an overview of legal conduct issues.

Ethical issues are more difficult to enumerate than legal issues. Individuals usually rely on personal values to navigate through conflicts between company practices, laws and regulations, and management directives. To help team members negotiate ethical issues; the authors provide these general guidelines [Ref. 22: p. 65]:

-Seek higher management guidance to confirm difficult choices for conflicts among the various codes of conduct.
-If asked to operate in a potentially improper manner, make sure that the request is written and verify it with the cognizant authority.
-Report any improper conduct, anonymously if necessary.

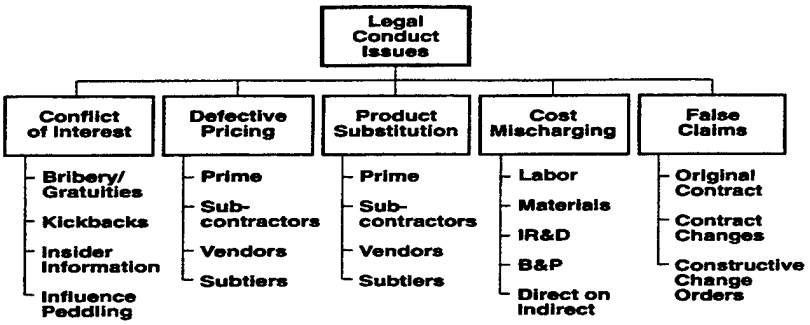

Figure 3-1 From [Ref. 22: p 65]. Legal Conduct Issues.

d) Shared Rewards

The concept of shared rewards is simple: effective rewards start with fair and equitable compensation for each position on the team. Individual members or the entire team can earn rewards. If the project manager prefers to divide cash awards among the team members, the authors recommend the money be given in small amounts so more can share. Another strategy offered is to simply spend the money on team recognition.

e) Team Spirit and Energy

This teamwork fundamental is a factor of personal attitude as well as company culture. The authors are careful to point out [Ref. 22: p. 67] that putting the team ahead of oneself does not mean that team spirit requires the elimination of independent "pace setters." The key for members with driven personalities is to allow them to exercise their assertiveness and energy without dominating teammates.

f) Techniques for Creating Teamwork

It is the responsibility of the project manager to draw on the strength of the team and to neutralize its weakness. To help prevent the manager from micro managing or providing too much freedom to the team, the authors present a list of responsibilities for the manager. Accordingly, the project manager must [Ref. 22: p. 67]:

-Clearly define unambiguous responsibilities.
-Define and communicate a project process and style.
-Delegate whenever possible.
-Empower the team to be accountable.
-Balance support with direction as required.
-Train the team, by example, to operate as a team.
-Deal with under-performers who drag the team down.
-Establish team-effort rewards.
-Design the tasks and work packages in a way to encourage teamwork.

Finally, managers need to confirm that their leadership is effective by measuring observable behavior. There are positive and negative indicators that a manager can observe to gauge the status of the team cohesiveness (Table 3.1) [Ref. 22: p. 73].

Positive Indicators	Negative Indicators
A positive cooperative climate prevails.	A climate of suspicion and mistrust exists.
Information flows freely between team members.	Information is hoarded or withheld.
No work is considered beyond an individual's job description.	Fingerpointing and defensiveness prevails.
Interpersonal interactions are spontaneous and positive.	Counterproductive subgroups and cliques begin to form.
The collective energy of the team is high.	Fear of failure causes individuals to avoid or postpone making important decisions.

Table 3-1. Positive and Negative Indicators.

3. Project Cycle

All projects pass through a sequence of events that the authors identify [Ref. 22: p. 32] as the "project cycle". Different organizations have their preferred project models from which they tailor to fit each specific project. The project cycle is used as a roadmap for the project to progress from "stake-to-stake", or from one milestone to the next.

Without the use of a field-tested, clearly defined sequence of actions for a project to follow, teams are forced to create their own "path". As a result, the consequences for not using a proactive framework for the project can be devastating. [Ref. 22: p. 76]

The project cycle template described by the authors is decomposed into many components and subcomponents. It has Periods, Phases within each Period, Control Gates, Activities, and Products. It also contains three "interwoven" layers, the Technical, Business, and Budget aspects that occur in parallel within the project cycle. [Ref. 22: p. 32]

a) Periods

The project template is divided into three periods: the Study Period, the Implementation Period, and the Operations Period (Figure 3-2). Each of these periods corresponds to the three major stages of a project as it progresses from the identification of the user's need, through concept determination, implementation, and finally to production and user operation. [Ref. 22: p. 77]

The study period is crucial to the project because it is during this time that the scope and funding is determined. Even though a project team must engage in considerable analysis and negotiation during the Study Period, a thorough study can often prevent lost time and wasted funds as the result of rework.

The Implementation period sets the contractual foundation for the project. Objectives for this period include choosing the highest value bidder, designing and building the first article, and testing and verifying the article in accordance with all specifications.

It is during the Operations Period that the user's needs are fulfilled and the project solution in achieved. In a government project the objectives for this period are: to transfer the system to the operational location and establish full operational capability, operating and maintaining the system according to the user's requirements, and identifying system

improvements for future use [Ref. 22: p. 82]. In commercial projects the system is delivered to users in the marketplace. Finally, in applicable projects, planning for deactivation takes place.

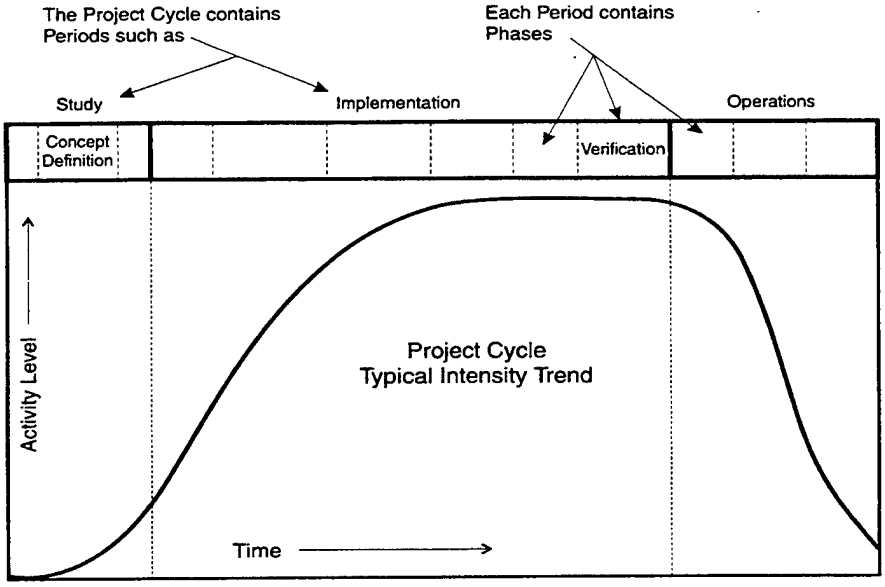

Figure 3-2 From [Ref. 22: p 33]. The Sequential Project Cycle.

b) Control Gates

The authors define a control gate as "a management event important enough to be defined and included to the schedule by executive management." [Ref. 22: p. 83] They are the major decision points in a project cycle that ensure the scheduled activities are completed successfully before allowing the pursuit of new activities. The primary objectives of Control Gates are listed as [Ref. 22: p. 83]:

> -To ensure that all current phase activities and products are complete.
> -To ensure that progression to the next set of activities is based on hard evidence that the team is prepared and that the risk of proceeding is acceptable.
> -To promote a synergistic team approach.

c) Activities

Activities are those specific actions taken by the project team to meet the goals of the project. Examples of these activities include [Ref. 22: p. 34]:

-Defining user requirements.
-Comparing trade-off candidate concepts.
-Developing a user validation approach.

d) Products

Products are the output of activities. Products usually need to be approved at the Control Gates. Examples of Products include [Ref. 22: p. 34]:

-System Concept Document.
-Specifications, drawings, and manuals.
-Internal hardware and software feasibility models.
-Deliverable hardware, software, and documentation.

e) Budget

The budget aspect is one of three layers to every project cycle and represents the activities and events needed to provide the project with the necessary funds throughout its cycle. The budget contains all events pertaining to the executive management appropriation of project funds and a project manager's securing of funds. [Ref. 22: p. 85]

f) Business

The business aspect contains all the events related to the overall business management of the project and associated contract management. One important business management event is pursuing and managing customers. Other events include activities needed to solicit, select, and manage the vendors who are participating in the project. [Ref. 22: p. 86]

g) Technical

The combination of the events from the three project cycle aspects constitute the total cycle (Figure 3-3). The budget and business activities are overlaid on the technical aspect to form the complete project cycle (Figure 3-4). Like the other two layers, the technical aspect of the project cycle contains its own set of events even though it occurs in parallel with the other two aspects. [Ref. 22: p. 33]

The technical cycle contains all the events related to satisfying the technical and quality requirements [Ref. 22: p. 35]. It identifies the activities and events from a system engineering perspective required to provide the most effective and efficient technical solution to the project requirements.

The actual process is best visualized as "Vee-Model" rather than in a horizontal format (Figure 3-5). The schedule maturity and time progress from left to right on the model. On the left side, one performs decomposition and definition while moving from system requirements and concepts down to fabrication, assembly, and code to "build-to" documentation. The right side of the Vee corresponds to an upward movement, aggregating the system's components at successively higher levels while performing integration and verification. [Ref. 22: p. 34]

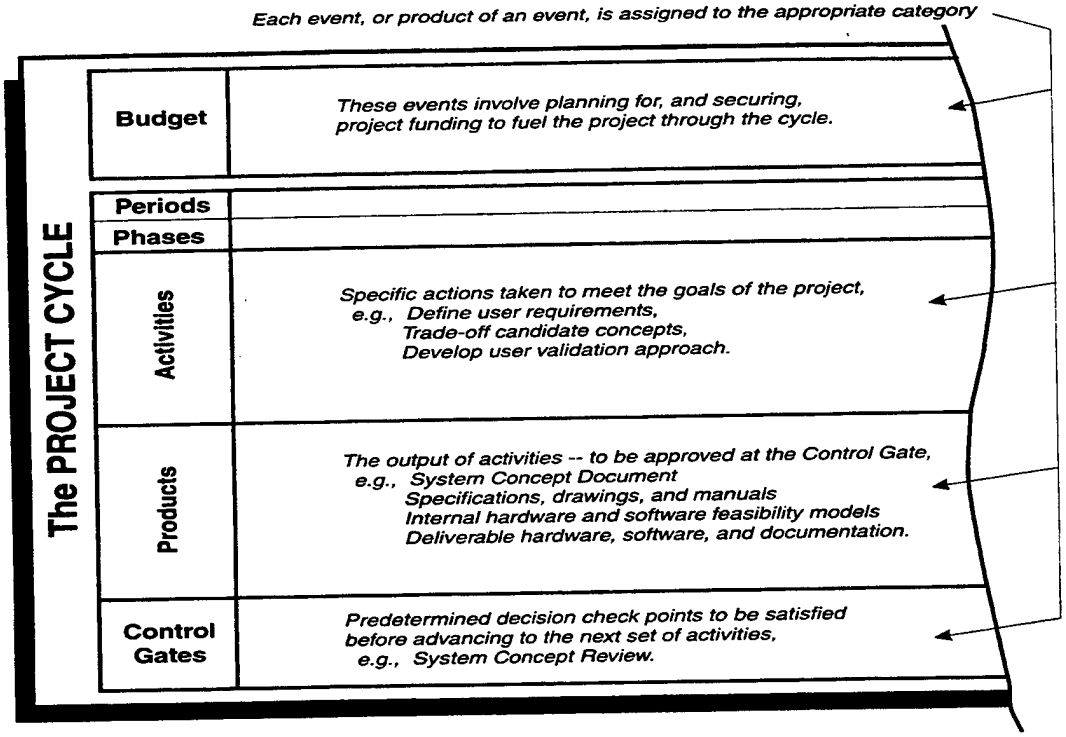

Figure 3-3 From [Ref. 22: p. 34]. Total Cycle Format.

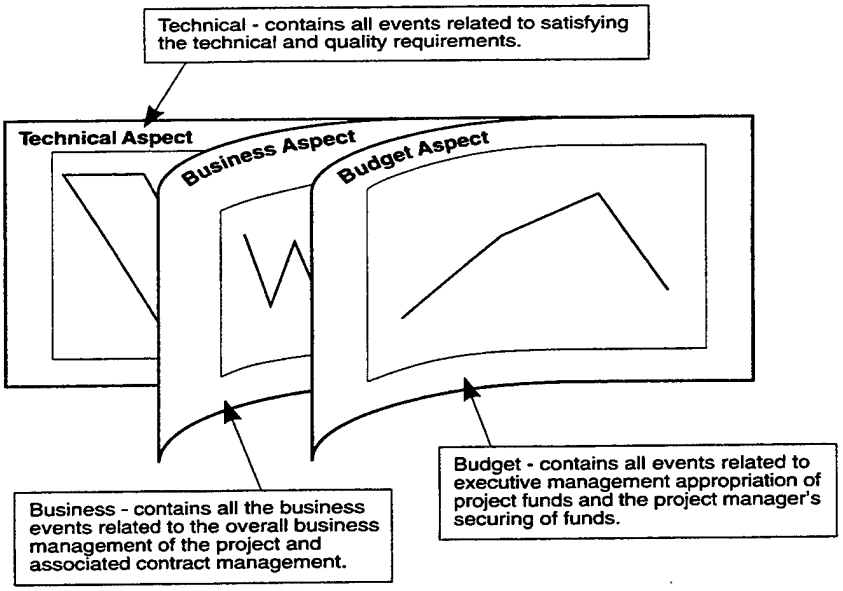

Figure 3-4 From [Ref. 22: p. 35]. The Three Aspects of All Projects.

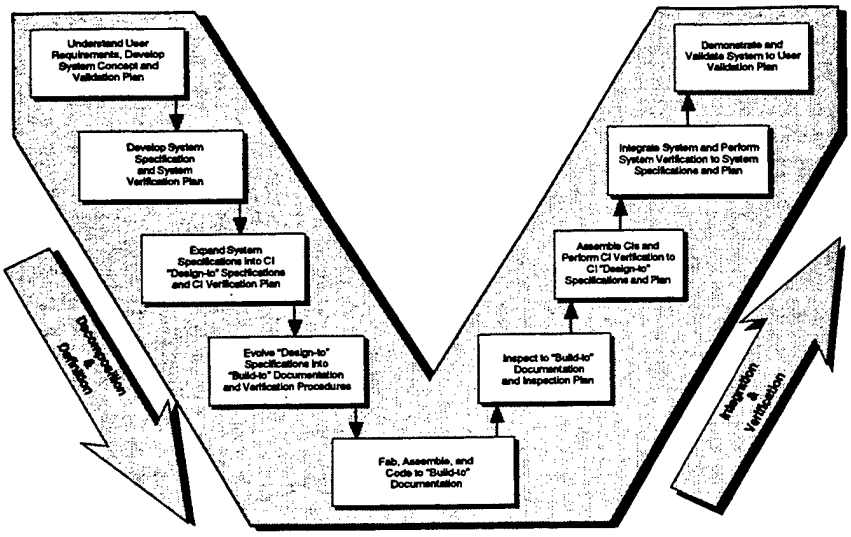

Figure 3-5 From [Ref. 22: p. 108]. The Vee Model.

The utility of the Vee format is in the capability to better visualize the direct correlation between the activities on the left and the right side of the model. One example of this correlation is the manner in which the model minimizes the chances that requirements are specified in a way that cannot be measured or verified. While using the Vee-model, the method of verification to be used on the right side must first be determined during activities on the left side before descending down to the next level on the left side.

One of the valuable uses for the Vee-model is as a tool for controlling the systems engineering process, which the authors define [Ref. 22: p. 37] as the application of the "Systems Analysis and Design" and the "Systems Integration and Verification" subprocesses to the technical aspect of the project cycle. These two subprocesses are further defined in the following Project Management Elements section.

Another valuable use for the Vee-model is as a tool for risk management. The Vee-model offered by the authors encourages detailed work early in the cycle to

reduce risk. An example [Ref. 22: p. 88] is the accommodation of hardware and software "requirements-understanding" and technical feasibility models in the first period. Risk identification and reduction modeling continues through the conduct of "off-core" activities (Figure 3-6).

Unlike decisions made during the off-core studies, only decisions made at the core of the Vee are put under configuration management at the appropriate control gates. These configurations comprise the baseline definition for the system under development.

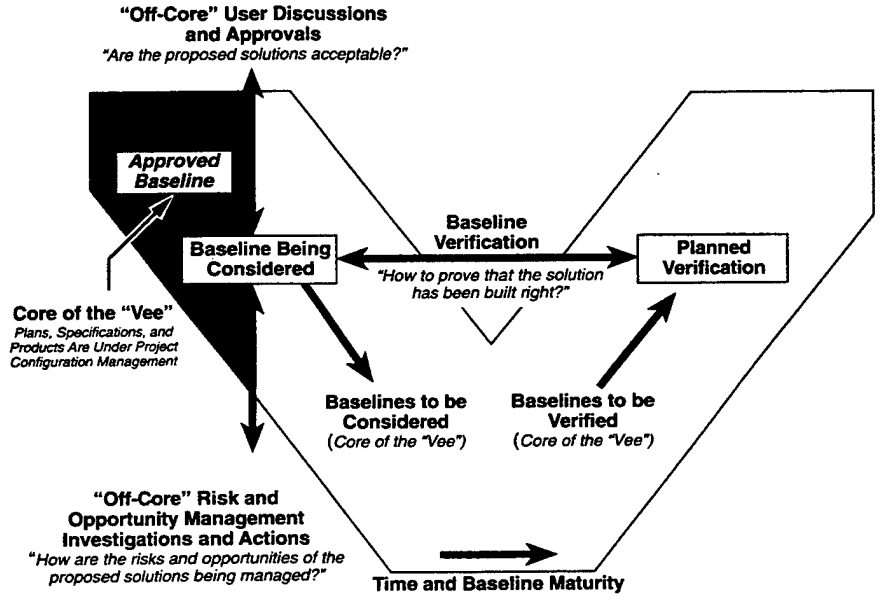

Figure 3-6 From [Ref. 22: p. 89]. Vee Model and Off Core Activity.

4. Project Management Elements

As the authors note, the technical, schedule and cost performance elements of a project do not complement each other. Rather, they are opposing forces that require a skillful blending to reach the best solution for the given situation. The Project Management Elements, applied situationally throughout the project cycle, provide the

tools and techniques needed to keep the aforementioned parameters in balance. [Ref. 22: p. 39]

The Project Management Elements consist of 10 categories of management responsibilities, functions, techniques, and tools that help manage [Ref. 22: p. 104]:

-All types of projects.
-All phases of the Project Cycle.
-All organizations participating in the project.

a) Project Requirements

The project requirements constitute requirement creation and management. The major documents created to support this element are the products referred to as "outputs" in the project cycle. The framework for applying this element is embodied by the Vee-model discussed in the previous section.

The first technique for determining requirements is the System Analysis and Design (SA&D) process. It is applied at every level of the decomposition and definition sequence while working down the left side of the Vee-model. The SA&D process is initiated by the higher level requirements and constrained by the approved baselines. There are several steps within the SA&D (Figure 3-7) [Ref. 22: p. 108]:

-Define the problem and evaluation criteria.
-Understand the context of implementation.
-Define the required behavior and performance.
-Develop candidate physical or logical solutions.
-Select the best solution.
-Get customer approval of solution and add to baseline.

The Systems Integration and Verification (SI&V) process is the counterpart to SA&D. It is an iterative process that is repeated throughout the integration and verification sequence while navigating up the right side of the Vee-model format.

SI&V provides the framework for using the verification criteria developed during the decomposition and definition process while inspecting and testing the systems integration that occurs at each level. Similar to SA&D, there are also several steps within the SI&V process (Figure 3-8) [Ref. 22: p. 116]:

-Inspect and test to verification requirements.
-Integrate with the next configuration item and repeat verification process.
-If needed, identify and correct deficiencies.
-If needed, document uncorrectable deficiencies.
-If needed, confirm impact of uncorrectable deficiencies.
-If needed, modify approved technical baseline to incorporate deviation.

Another requirements management responsibility is the "traceability" and "accountability" of project requirements. The purpose is to ensure that all requirements have been incorporated into the design and that requirement satisfaction is verified by test, inspection, demonstration, and if needed, analysis. [Ref. 22: p. 118]

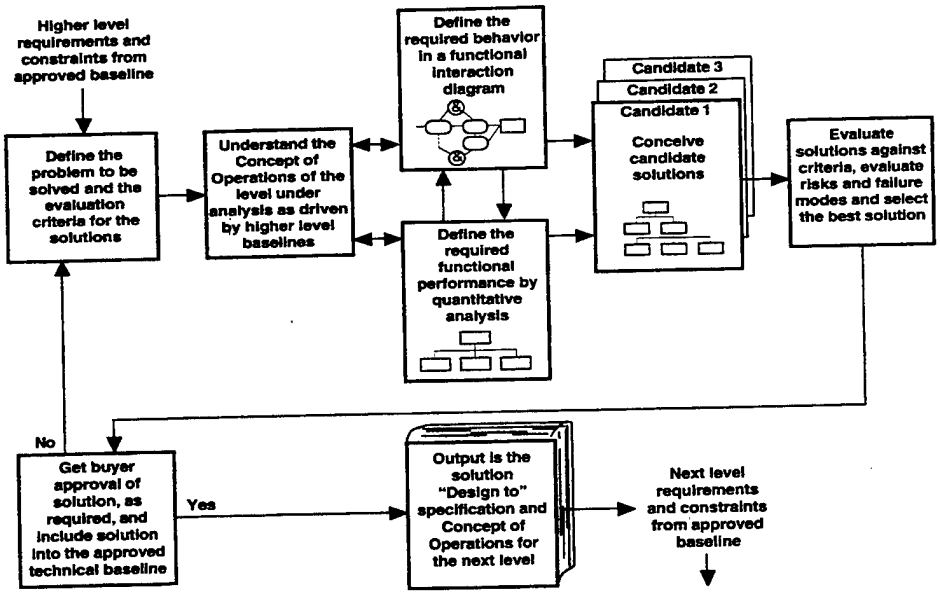

Figure 3-7 From [Ref. 22: p. 110]. System Analysis and Design Flow Chart.

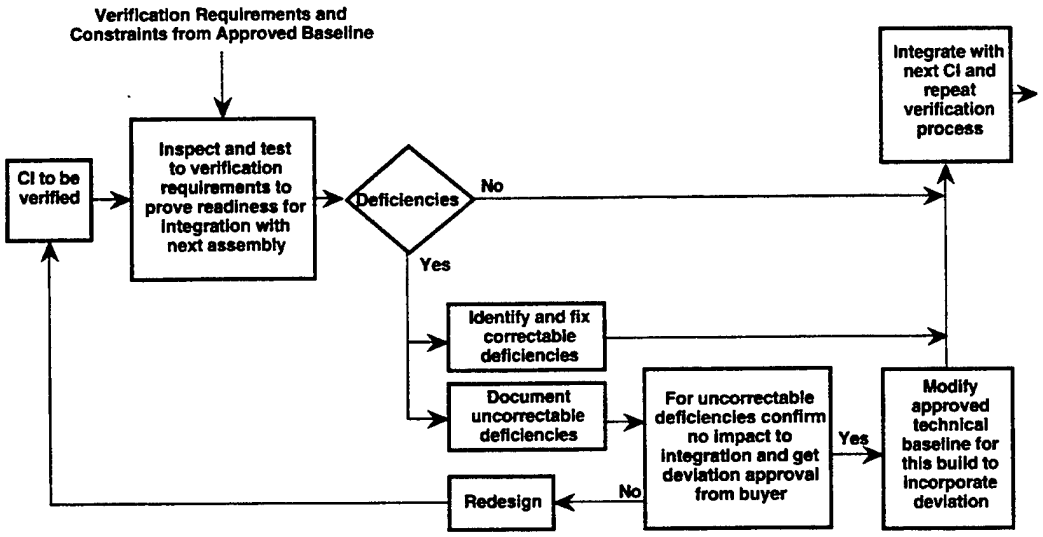

Figure 3-8 From [Ref. 22: p. 116]. System Integration and Verification Flow Chart.

b) Organization Options

The proper organizational structure can contribute significantly to the project's performance and efficiency. Conversely, over-complexity or redundancy in organizational design can lead to confused responsibility and inefficiency. To find the best organizational fit, it is important to ensure that project requirements are considered because each project presents a unique set of organizational requirements. The authors present several organizational structure options and the relative strengths and weaknesses for each: [Ref. 22: p. 128]

> -Pure functional: This organization is rated as the best for a single project that is relatively independent in interface or technology. It is rated as not good for any organizations that are managing multiple projects.
> -Pure project: This option is rated as the best choice for projects that prioritize the schedule or cost performance as high and development costs as relatively unimportant.
> -Conventional matrix: This organization configuration works best if the project manager controls the funds and has well defined interrelationships with the supporting managers. However, the matrix fails in those circumstances where the project manager is

viewed as a "coordinator" and the support managers operate on a "best effort" basis.
-Collocated Matrix: Managers should consider this option for very high priority projects that depend on critical resources and technologies, and when on-going involvement with company strategy is secondary.

c) Project Team

Team formation is a situational process that is ongoing throughout the project life-cycle. This is because the process of forming the team involves more than just determining staffing; it also encompasses the definition and management of interfaces with project stakeholders such as supporting organizations, contractors, upper management, and the customer. [Ref. 22: p. 132]

As a part of the team staffing strategy, senior management should document job responsibilities prior to selecting the project manager. The authors state [Ref. 22: p. 134] that this documentation should establish responsibility for:

-Establishing the team and teamwork environment.
-Inspiring and motivating the team.
-Ensuring all project requirements are clearly defined and documented and disseminated to the lowest level.
-Ensuring the controls are in place and effective.
-Controlling baseline requirements through a change control system.
-Ensuring that the visibility techniques are in place and effective.
-Determining the frequency and the level of status that is appropriate for the project.
-Timely execution of corrective action to recover the project plan.

The project manager is the key person on the project team. As the authors have noted [Ref. 22: p. 135], the project manager must interface in three different areas. He or she must meet the requirements of the customer, answer to senior management, and provide a positive work environment for the project team. Therefore, selecting the project

manager is a critical matchmaking task for upper management that is crucial to the project's success. The authors provide [Ref. 22: p. 136] a sample "competency model" that can be used when selecting a team member as an objective basis for evaluating the key competency factors required for a particular project. Figure 3-9 depicts a model that is tailored for selecting a project manager.

The project manager needs to determine the required functions and related skills as shown in Figure 3-9 before selecting team members. For this task, the nature of the project will guide the project manager. It is also important to select the core team from people who have previous experience at the task or project management level.

Rating Factor	Basic	Score	Advanced	Score	Expert	Score
Project Management Training	Has had some project management training		Has had the company's or equivalent project management training		Has had the company's, PMI[1], or equivalent certification in project management	
Project Management Experience	Has served as a deputy or assistant project manager		Has been a successful project manager		Has managed several successful programs	
Contracting and Negotiating	Is knowledgeable of types and applications of the relevant contract types		Has participated in developing contract negotiation strategies		Has considerable experience in contract negotiation strategy and participating in negotiations.	
Sub-contracting	Is knowledgeable in the difference between purchasing and subcontracting		Has participated in the selection and award of subcontracts		Has successfully managed subcontractors	
Decision Analysis	Is aware of the importance and practice of Analytical Decision Analysis[2]		Has been trained in Analytical Decision Analysis[2]		Has been trained and routinely practices Analytical Decision Analysis[2]	

Figure 3-9 From [Ref. 22: p. 136]. Example Competency Model.

In addition to the project manager, there are two other important positions that make up the core of the team: the systems engineer and the business manager. The systems engineer is responsible for the project's technical integrity while meeting the cost and performance objectives. The business manager is responsible for all the business

aspects of the project to include planning, scheduling, and contract matters. [Ref. 22: p. 139]

d) Project Planning

The authors define planning as "the process which determines beforehand the activities necessary to complete the project." [Ref. 22: p. 148] At the total project level, planning is performed in each project cycle phase. As a result, the overall plan is composed of separate plans for each period and phase of the project (Figure 3-10). At the most basic level, the plan contains [Ref. 22: p. 149]:

-What is to be done.
-When it should be done.
-Who is responsible for doing it

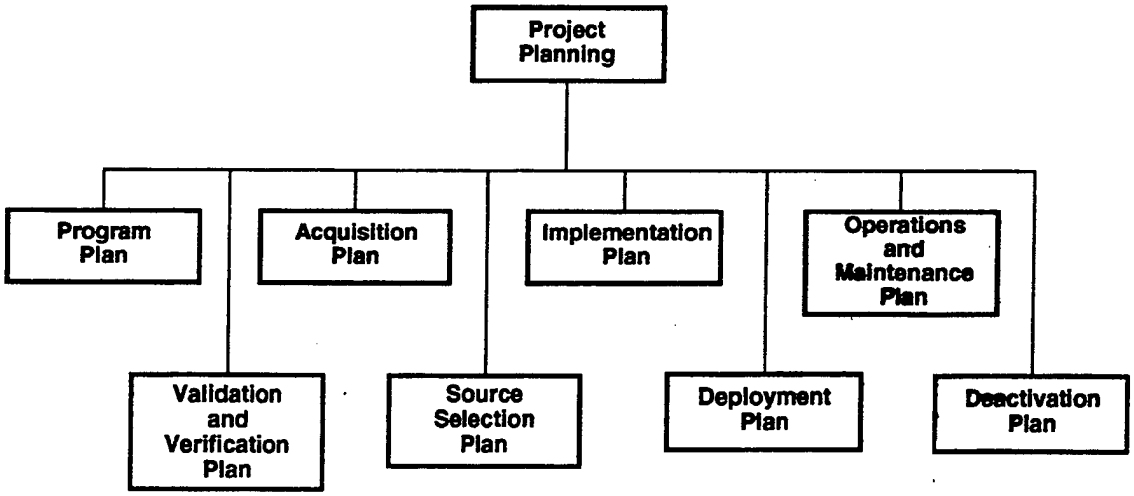

Figure 3-10 From [Ref. 22: p. 149]. The Total Project Plan.

The goal of planning parallels the goal of the project: ensure that the commitments made to the customer are met. To determine the project deliverables, and provide a description of each, the authors recommend [Ref. 22: p. 155] that project managers use the Project Product List (PPL) and Fact Sheets. The PPL and Fact Sheets

are derived from system decomposition and definition and are a listing of all contract deliverables, and their quantities required.

The Work Breakdown Structure (WBS) is a method used to decompose a system by assemblies, subassemblies, and components instead of by functional organization or discipline (Figure 3-11). The WBS is essential for project planning because it becomes the basis for work assignments, budgeting, scheduling, risk assessment, cost collection, and performance statusing. The authors offer the following guidance when preparing a WBS for hardware or software related project [Ref. 22: p. 158]:

-Structure the WBS by product and elements of the product.
-Include all authorized tasks.
-Place cost collection one level below budget performance report to facilitate problem cause identification.
-Ensure identifiers for like tasks are similar.
-Collect all tasks for an element with the element identifier.
-WBS depth depends on the risk to be managed and reported.

The WBS provides an essential foundation for the project network and for scheduling. To create this foundation, the tasks devised from the WBS are combined to form the project network from which the scheduling will flow (Figure 3-12).

While there are other methods such as the Project Evaluation and Review Techniques (PERT) and the Critical Path Method (CPM) for developing a schedule, the authors promote their own process called "cards-on-the-wall" (COW) [Ref. 22: p. 163].

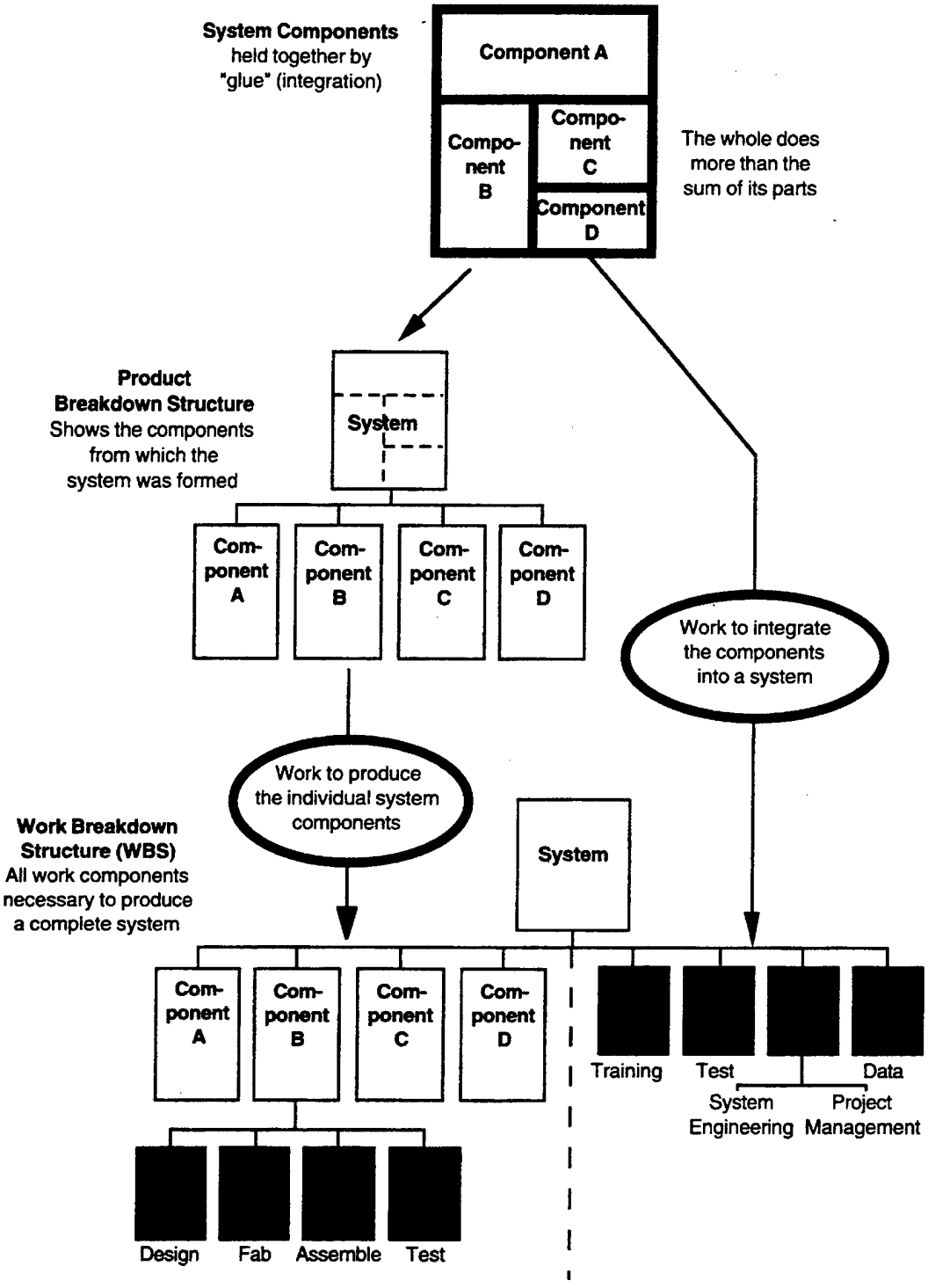

Figure 3-11 From [Ref. 22: p. 159]. The Work Breakdown Structure.

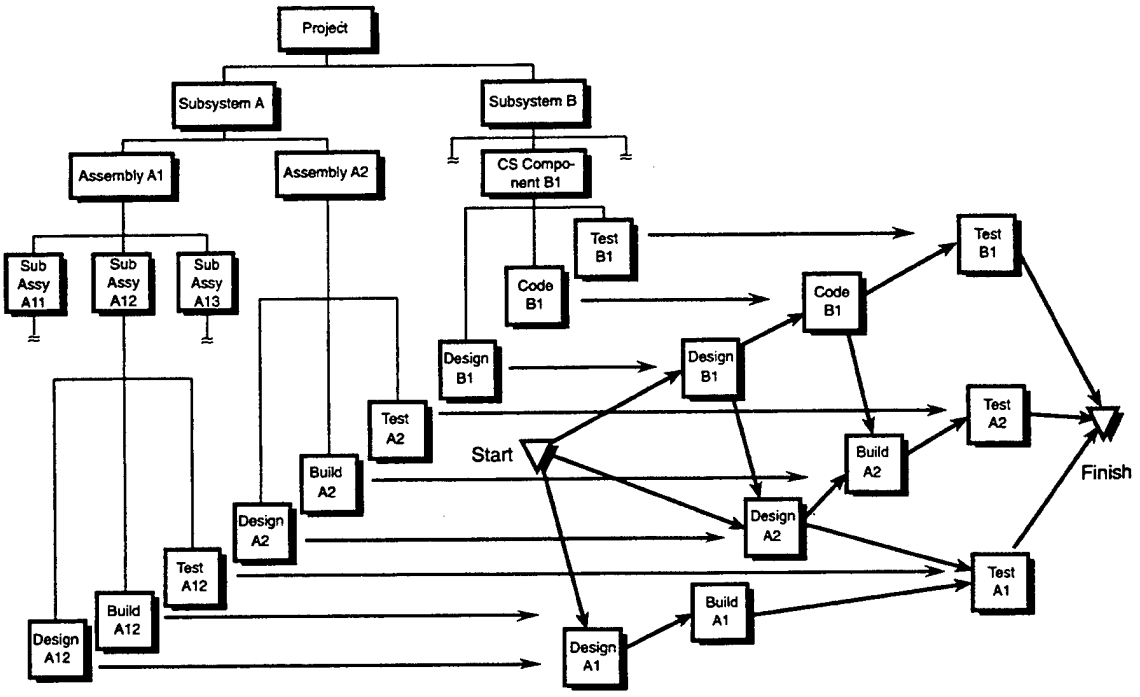

Figure 3-12 From [Ref. 22: p. 162]. The Work Breakdown Structure Tasks Related to the Project Network and Schedule.

The drawback to PERT and CPM is that they allow a single person, using automated tools, to complete the construction of the schedule. However, the COW method facilitates the interaction of the team because the members post the separate work packages, by project phase, on the wall for all to see. This method allows all of the members of the team to congregate and provide input to the planning process as well as exposing them to the interdependencies of each work package.

Using the COW method, the authors present several steps from which the scheduling process iterates [Ref. 22: p. 162]:

-Combine the tasks to form a project network.
-Define and evaluate risks.
-Develop risk mitigation actions and add to the network.
-Factor in task duration time.
-Determine the critical path.

-Shorten the critical path.
-Commit to performing to the task schedules.

Devising a solid, coherent plan provides many benefits to the project manager. Interfacing with the other stakeholders, obtaining resource commitments, and reacting to unforeseen circumstances becomes easier because of the lack of ambiguity. In addition to the techniques mentioned in this section, the authors provide [Ref. 22: p. 153] a table of major elements and techniques for planning (Figure3-13).

Key Element	Process	Primary Technique
Products	*Decomposing* the deliverables into their hierarchical structure—all the way from the project requirements down to the lowest level internal and external deliverables.	Project Product List and Fact Sheets
Tasks	*Defining the tasks* needed to complete each deliverable.	Work Breakdown Structure
Strategy	*Identifying the risks* and opportunities and the customer-compatible risk and opportunity strategy with preventive, causative, and contingent action plans.	Lessons Learned
Network	*Logically arranging* the required tasks to portray the best delivery approach.	Cards-on-the-Wall network, followed by a computerized network and critical path determination.
Schedules	*Scheduling* each task then refining and shortening the project's overall critical path through iterative steps.	Scheduling software
Resources	*Establishing* resources (personnel, equipment, finances) needed to accomplish each task on schedule.	Spread sheets and cost estimating models
Commitments	*Committing* the necessary resources and funds for each task as determined from the schedule and task definition.	Project Work Authorizing Agreements

Figure 3-13 From [Ref. 22: p. 153]. Major Elements and Techniques for Planning.

e) Risks and Opportunities

Risk and opportunity management is a critical part of the planning process that is performed simultaneous with the project plan, however, it uses a separate and unique process. The authors provide specific steps for risk and opportunity management to allow a project manager to make conscious, distinct arguments for management actions. This structured process is ongoing and applied to the project as it evolves [Ref. 22: p. 176]:

-Identify the risks and opportunities.
-Assess both probability and impact and then forecast the outcome.
-Compare the outcomes and prioritize.
-Develop feasible management actions to enhance opportunities and mitigate risks.
-Estimate the cost of proposed immediate and contingent actions.
-Compare resultant changes to weighted value against action costs.
-Decide on actions required, and obtain concurrence.
-Document and incorporate decisions in all planning.

There are several methods available to help identify risks and opportunities. They range from off-core studies to scenario planning and failure mode analysis. While the techniques vary, the common principle is the same: to properly identify the risks and opportunities, the project team must systematically apply an appropriate method through each phase of the cycle. [Ref. 22: p. 174]

The Weighted Value (WV) method provides a good tool for the project manager to assess the probability and the impact of risk and opportunity. The WV is relatively simple to quantify. It is the probability of occurrence multiplied by the cost of the impact of that event occurring. For example, if the probability of an event occurring is .8, and the impact of that occurrence is $100,000, then the weighted value for that risk is $80,000. [Ref. 22: p. 182]

Quantifiable measures permit a project manager to continue with the risk and opportunity management process. The identified and quantified WV calculations allow the project manager to compare and prioritize events. Armed with a prioritized list of risk and opportunity events, management can then make a plan for influencing either the probability of occurrence or the impact on the outcome through the application of mitigating or enhancing activities. Once this process is complete, the mitigating actions can be incorporated into the project plan.

f) Project Control

Project control is process control. Further, process controls are needed at every level and in each project activity because projects without adequate process control usually fail. The authors present a dual system of process control designed for reducing risk [Ref. 22: p. 191]:

> -Baseline Control: Proactive control of the Project Plan and changes to the plan to help ensure that events happened as planned, and that events not planned do not happen.
> -Performance Control: Reactive control of variances in the performance of the Project Plan or corrective action taken when unplanned events do happen.

For maximum effectiveness, controls need to be tailored to the project and in place before it begins. Proactive and reactive measures should be relevant, efficient, simple, and timely. To achieve these goals, the authors list five essential considerations to a control process [Ref. 22: p. 191]:

> -Things to be controlled: The function that must be controlled to a standard of performance.
> -Control Standard: The acceptable standard of performance.
> -Control Authority: The person or organization that imposes the standard and can grant exceptions.

-Control Mechanisms: The forum or device that measures and controls conformance to the standard.
-Variance Detection: The identification of deviations of the control process or violations of the standard.

An example of process control is the application of these considerations to "schedule control." In this example the schedule is the thing to be controlled, the master schedule is the standard, the business manager is the authority, the change board is the mechanism, and the status review provides the variance detection. [Ref. 22: p. 43]

g) Project Visibility

Project visibility is the means by which the project manager and project team know the status of their project activities. Project visibility techniques change as the project advances through the project cycle. They are determined by the timing, critical need, and geographic location of the required data. There are several techniques presented by the authors to gain visibility for project activities. Among these methods are meetings, reports, tiger teams, and glance management. [Ref. 22: p. 212]

Glance management includes any number of informal follow-up techniques such as "management-by-walking-around" that provides awareness of a project's status with a quick glance. Other examples of this type include sampling work in progress, sitting in on lower level meetings and engaging in conversations before or after meetings. [Ref. 22: p. 213]

Tiger teams are used to focus on trouble areas. Members of these teams are usually technical experts or experienced troubleshooters that can provide an objective, third party perspective of the problem. The ultimate objective of a tiger team is to identify the cause of a problem without trying to assess the blame. [Ref. 22: p. 216]

h) Project Status

Project statusing is the measurement of the progress of the project against the project plan. The goal is to identify variances that require corrective action to restore the plan. The authors contend that an effective process for statusing [Ref. 22: p. 224]:

-Collects essential information only.
-Measures primary variables that impact results.
-Tailors information to the needs of the team members interpreting it.

Project managers should always know the status of four primary factors: schedule, technical, cost, and business. Table 3-2 provides the key metrics for each of these factors. [Ref. 22: p. 225]

Schedule	Technical	Cost	Business
Progress summary	Development results	Actual versus budget	Contract change process
Master schedule	Design release	Headcount	Actions to/from customers
Milestone accomplishments	Technical review	Earned value vs. expenditures	Action to/from management
Assemblies and modules	Technical performance measurements	Burn rate and overtime ratio	Actions to/from contractors
Tasks	Interface control	Estimate to completion	Funding
Subcontractors	Quality	Estimate at completion	Top-ten problems
Parts and material	Design Change rate	Profit	Security clearances
Earned value		Dispersion ratio	Project manager's assessment

Table 3-2. Status Factors and their Key Elements.

The authors provide several examples of methods to measure the status of these key factors. One of these methods is to use the quantity of milestones as a schedule metric (Figure 3-14) [Ref. 22: p. 228]. Another example provided is a Total and Experienced Headcount variance report to anticipate cost and schedule problems (Figure 3-15) [Ref. 22: p. 229].

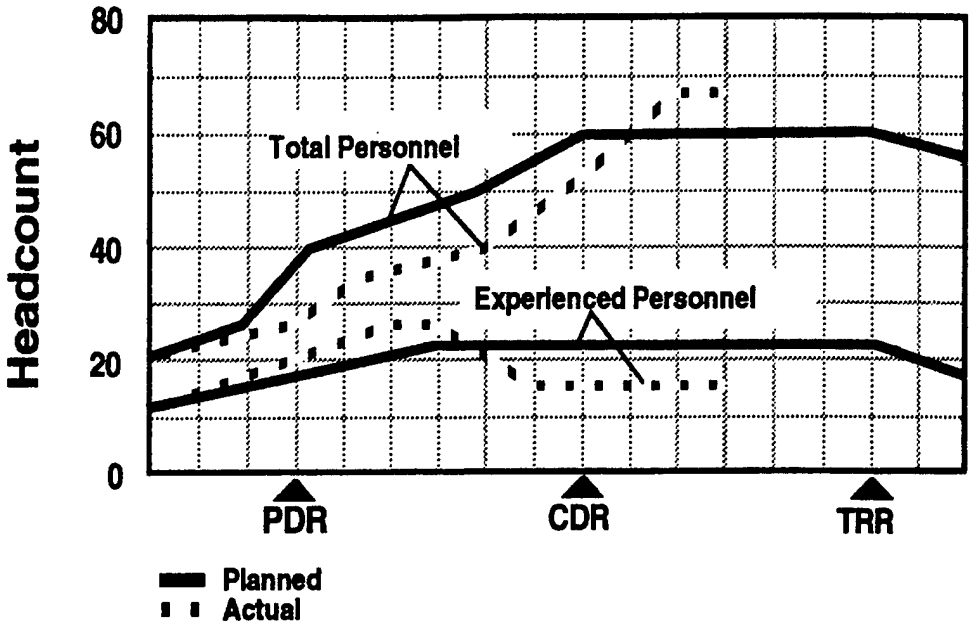

Figure 3-14 From [Ref. 22: p. 231]. Headcount Variance Report.

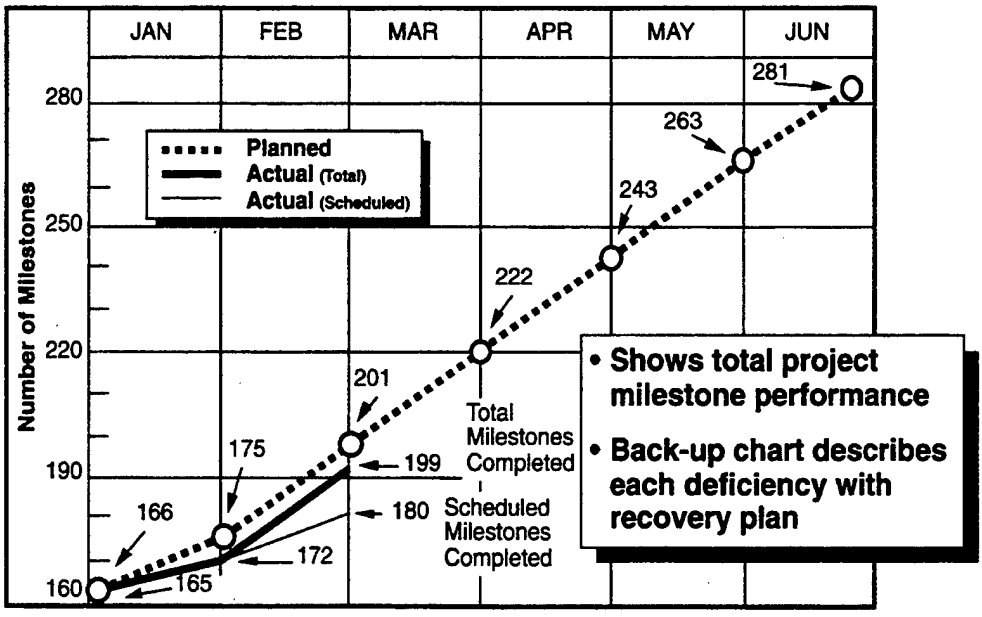

Figure 3-15 From [Ref. 22: p. 228]. Milestone Status Report.

One of the more prevalent systems used today to refine performance measurements is the Earned Value (EV) method. While the EV method requires detailed planning to establish and maintain, it provides a manager with a powerful tool to provide early warning of problems by relating cost, schedule and technical progress. Figure 3-16 illustrates an application of the EV method to a project. [Ref. 22: p. 233]

In this example, the metrics denotes that the project depicted in Figure 3-16 is behind schedule and over budget. The variance between the Budgeted Cost of Work Performed (BCWP) and the Actual Cost of Work Performed (ACWP) signifies that the actual costs of completing the tasks exceeded the budgeted costs and therefore the project has expended more funds than anticipated at that point in the schedule. The variance between the BCWP and the Budgeted Cost of Work Scheduled (BCWS) connotes that the project has performed less work than scheduled. Through comparisons of these and other metrics, the project manager can interpret trends and anticipate the eventual cost of the completed project.

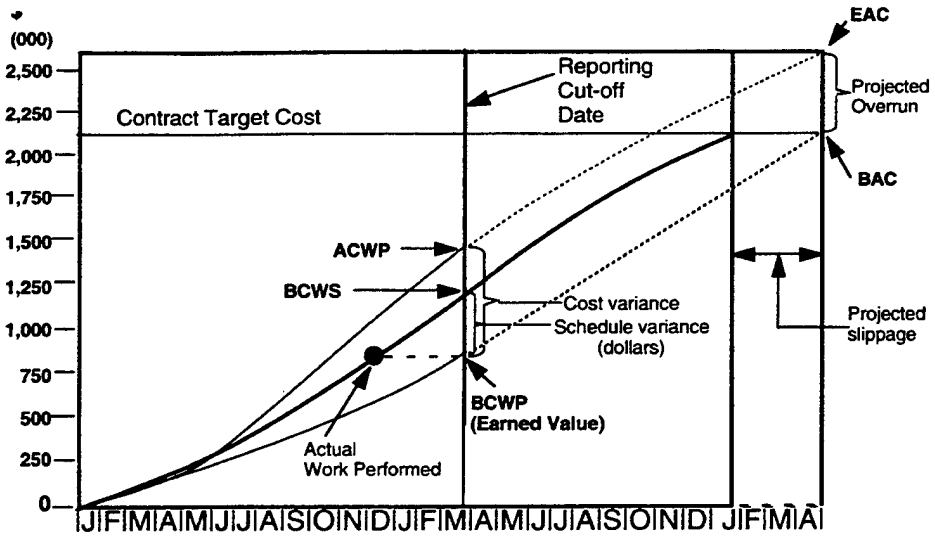

Figure 3-16 From [Ref. 22: p. 233]. Earned Value Chart.

i) Corrective Action

Corrective actions are those steps management takes to restore the project to the plan. These actions are usually triggered by unacceptable variances discovered through the use of statusing techniques. By monitoring variance and recognizing an imminent or actual breach of a predetermined threshold, a manager maintains the possibility of regaining lost control over a project. By taking corrective action in a timely manner, a manager can restore control of the project.

According to the authors, the steps for corrective are as follows [Ref. 22: p. 241]:

> -Analyze the problem, its current impact, and the growth of the impact if no action is taken.
> -Prioritize project problems from the most to the least serious.
> -Determine the best approach using analytical decision analysis.

Examples of corrective actions are overtime, added work shifts, or an alternate technical approach. Figure 3-17 illustrates the use of an analytical tool to help evaluate alternatives for corrective action that requires adjusting the work shifts.

Evaluation Criteria		**Alternative 1 One 12 hr shift**			**Alternative 2 Two 8 hr shifts**			**Alternative 3 Three 8 hr shifts**			**Alternative 4 Two 12 hr shifts**		
Musts (Go-No Go): • Certified Software Testers • Available within 3 weeks								X X					
			Score			Score			Score			Score	
Wants	Weight (W)	Comments	Raw	R x W	Comments	Raw	R x W	Comments	Raw	R x W	Comments	Raw	R x W
Factors													
Maximizes productivity	10		5	50		7	70					10	100
Highly experienced in our software	8		10	80		8	64					8	64
Low average labor rate	8		7	56		10	80					5	40
Max Score (10xW)	260												
Total Score				186			214						204

Figure 3-17 From [Ref. 22: p. 244]. Evaluation by Weighted Scoring.

j) Project Leadership

According to the authors [Ref. 22: p. 44], Project Leadership is the most important of the 10 project management elements. Project Leadership is the bonding agent that holds the previous nine project management elements together. It is through the proper exercise of leadership that the other nine elements are used. Three aspects of project leadership are addressed [Ref. 22: p. 246]:

-Situational leadership model, or the relationship of leadership to management.
-Techniques for inspiring and motivating individual and group performance.
-Style, or determining and communicating your leadership style.

To portray the situational nature of leadership, the authors use an orthogonal model (Figure 3-18). The cylinder represents the sequential actions for a typical task. The disk represents the project management elements held together by the rim of project leadership. The orthogonal positioning of the techniques of leadership represent their situational application to the project relative to the project cycle and current circumstances.

To motivate the project team, project managers should apply several techniques. They need to communicate their vision for success to the project team. They must also create the environment to enable the team member to achieve the stated vision or goals and recognize team members for their good performance. Project managers especially need to draw on their subordinates' strengths as well minimizing their weaknesses. Finally, project managers need to set the example by acting as they want the team to act.

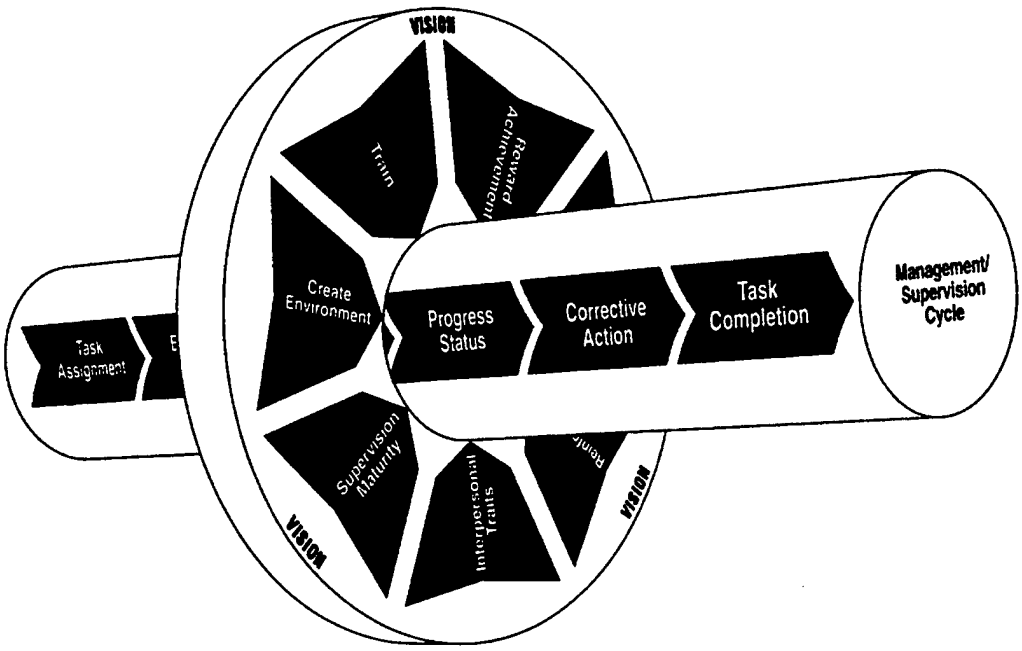

Figure 3-18 From [Ref. 22: p. 250]. Orthogonal Project Management Model.

D. CHAPTER SUMMARY

The program management model is critical to the DoD Acquisition system because it provides a single point of contact that acts as an "integrator" for a complex system of related functional disciplines.

The criticality and complexity of program management makes it an ideal topic for which to develop an automated program that incorporates a qualitative review capability currently lacking within the DAU course offerings. The remainder of this thesis focuses on developing such a program, which will be referred to as an "Automated Tool for Acquisition Program Management Students" (ATAPMS).

The next chapter details the content, structure, and topic requirements for an ATAPMS model tailored to the needs of instructors at the NPS.

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IV. STRUCTURE AND CONTENT REQUIREMENTS

A. INTRODUCTION

This chapter develops the structure, strategies and topics for an ATAPMS tailored to the NPS. Because the Vee-model described in chapter three is a useful concept, this thesis uses its requirements definition principles as a guide to help determine the requirements and specifications for an ATAPMS model.

B. STRUCTURE

The structure defines the top-level requirements for the application of an ATAPMS tailored to the NPS. The first step for determining the structure corresponds to the first step in the Vee-model: understand the user's requirements [Ref. 22: p. 36]. Feeding into the user requirements and system concept phase of the Vee-model is the "Statement of User's Needs" [Ref. 22: p. 187]. In the case of this application of an ATAPMS, the NPS requires an automated program to use in a laboratory setting to assist with the instruction of Acquisition Program Management. The users for this ATAPMS are identified as the instructors in the Systems Management Department of the NPS who teach Acquisition Program Management related courses. Personal interviews conducted with six of these faculty members verified several of the important characteristics necessary to determining the overall structure of an NPS ATAPMS.

While there were several areas of concern relating to the overall structure, based on the interviews, the most relevant to an ATAPMS are the approach, setting, scope, scalability, and distance learning considerations.

1. Approach

There are two basic approaches evident in the automated tools used by the DAU consortium schools to provide instruction to students: tutorial and capstone.

The tutorial approach is designed to expose the student to new information. This is the approach currently used by the DSMC in introductory courses like Acquisition 101 that are accessed through the Internet. [Ref. 23: p. 1]

The other method is the capstone approach exemplified by the SAFE application. This method does not try to teach the student new material, instead it reinforces or integrates concepts that the students learned as a prerequisite to participating in the class. The capstone approach reinforces these concepts by requiring the students to apply learned concepts to the problems presented by a real world scenario.

The NPS ATAPMS should follow the capstone approach because according to the instructors interviewed, there is a greater need for that type of application than for the tutorial method. In fact, other than the SAFE program, there are no capstone type automated programs used at the NPS or within the DAU consortium to assist with the instruction of Acquisition Program Management.

2. Scope

Because the NPS instructors will be the primary users, the ATAPMS should accommodate the NPS quarterly course class length. Courses are taught at the NPS on a quarterly schedule with each quarter 12 weeks in length. Generally, the first and last weeks are not conducive to conducting laboratory exercises, so the scope of the ATAPMS should be to accommodate 10 weekly sessions.

3. Setting

There are three different scenarios likely for students using an ATAPMS. Two of these scenarios involve the resident classroom laboratory environment and one involves an ATAPMS used in a non-resident distance learning capacity.

a) Resident Students

One of the classroom scenarios involves accessing the module for the first time beginning at the start of that week's laboratory session, and the other involves students accessing the module's material a day or more prior to the start of the lab session. The NPS ATAPMS should be designed to incorporate the latter setting. The advantage to allowing students to access materials before the requirements are due is that the students will have more time and opportunity to work with the material. This additional time will also allow for the inclusion of more detailed scenarios and should ultimately translate to a more meaningful learning experience.

b) Non-Resident Students

The second scenario envisions the use of the ATAPMS to support distance learning. A program designed with more involved scenarios and thought provoking material for resident students will accommodate non-resident students as well. Designing the ATAPMS to include more detailed material allows for an easier migration from the traditional resident lab sessions to distance learning sessions. This is in part because detailed course material will naturally support the non-resident students enabling them to work more autonomously.

4. Scalability

One theme evident from the research is that there does not appear to be any one specific design solution to fit the acquisition academic communities' requirements. Of the six instructors interviewed, each had subject matter topics and strategies for presenting those topics that were unique to their needs. They also had students with a variety of educational backgrounds who were pursuing different tracks in the acquisition field.

To be useful, an ATAPMS must be flexible enough to conform to each instructor's needs. One method of accomplishing this flexibility is to design the ATAPMS using a modular architecture that allows the replacement or addition of any one module without affecting the rest of the program. With this design format, each week's session would be a stand-alone module providing the instructors a "plug and play" capability. Given this flexible format, instructors would have the ability to select the appropriate modules and present them in the most appropriate order to best tailor their learning objectives to their category of students. [Ref. 24]

Another advantage to the modular structure is the ability to add new modules on an as needed base with minimal cost or disruption to the existing program [Ref. 24]. This feature will allow an ATAPMS to stay relevant and to continue to serve the academic classroom by adjusting to changes in the acquisition field. In contrast, the SAFE program discussed in a previous chapter does not share these advantages, and its inflexibility is a common complaint shared by a number of the instructors interviewed.

5. Distance Learning Considerations

Even though the current users for the ATAPMS are resident students, the intent of EO 13111 and the Defense Reform Initiative are clear: DoD schools need to take advantage of technology to help make education more accessible and at less cost.

Several of the schools within the DAU consortium already use distance learning technology to some extent. NPS has provided video teleconferencing courses for several years [Ref. 25]. The Defense Systems Management College [Ref. 23] and the Information Resources Management College [Ref. 26] are just two of the DAU consortium members that provide computer based distance learning courses. To insure that the ATAPMS meets Presidential and DoD intentions and that it is capable of supporting the distance learning requirements of the future, it should be compliant with Instructional Management Systems standards and be designed to meet the end-state goals of the Advanced Distance Learning Initiative.

The vision of the ADL initiative is to "provide access to the highest quality education and training, tailored to the individual's needs, anywhere and anytime in the world."[Ref. 27] The ADL initiative attempts to achieve this vision by transitioning from the current model of training which is classroom centered to a model that is network centered. To foster the network centered model, the ADL initiative established several goals that a distance learning application should meet. These end-state goals are: accessibility, interoperability, durability, re-usability, and cost effectiveness. [Ref. 28]

a) Accessibility

Accessibility refers to the student's ability to have access to the course modules from a variety of remote locations. Ensuring modules are designed with the

capability to be accessible through the Internet is the current method of meeting this goal [Ref. 15].

b) Interoperability

Interoperability refers to the student's ability to use a module at his location even though the module was developed at a different location on a different platform or with a different set of tools. Current indications from the software industry are that an object-based approach will provide the basis for this platform neutral goal [Ref. 16].

c) Durability

A durable module is a module that is robust. It requires no re-work or re-coding when the base technology changes.

d) Re-usability

Re-usability refers to the capability of the module to be used in multiple applications. The benefit will be a module that saves development time and money. The same object oriented approach necessary for interoperability also provides the basis for re-usability [Ref. 13].

6. Baseline Summary

Using the Vee-model method, it is now possible to establish a baseline for the structure of the NPS ATAPMS before determining the content. The following list summarizes the proposed requirements for the ATAPMS' top-level structure:

-Use a capstone style approach to the content.
-Accommodate at least 10 weekly topic modules.
-Capable of presenting well developed thought-provoking scenarios and questions.
-Ensure modular architecture for scalability and a plug and play capability.

-IMS compliant.
-Ensure Accessibility.
-Ensure Durability.
-Ensure Re-usability.
-Ensure Cost effectiveness.

C. CONTENT

Having determined the structural requirements, it is now possible to develop a set of top-level content requirements. Because the research revealed that the content requirements were so varied, and the proposed structure is flexible enough to accommodate them all, there is no need at this time to propose a final solution set for the content requirements. Therefore, it is not within the scope of this thesis to attempt to mature the content requirements to the point of recommending them as the approved baseline. The content proposed in this section will address the most recurring content needs as revealed by the research, and subsequent sections of this thesis will draw from this content for the purpose of off-core prototyping as a proof of concept measure.

Through the course of the research, it became evident that the content consisted of two distinct parts: topics and strategies for presenting the topics. An analysis of the literature review and instructor interviews revealed that material for instructing Acquisition Program Management can easily be grouped or categorized by logical topics. However, depending on the objectives for a particular course, the material included or emphasized within the topic presented to the student may be different. For example, Acquisition Strategy is a topic that equates to the Project Cycle described in chapter three. The material related to timeline and deliverable expectations used in this topic will differ if the objective is to emphasize a Major Automation Information System instead of a Major Defense Acquisition Program [Ref. 29]. The following sections present a listing of

topics and strategies that are not meant to be all-inclusive, but they are representative of the recurring information derived from the literature review and instructor interviews.

1. Topics

The explanation of each topic presented in this section will present a higher level, more generalized description because each topic's content is influenced by the relationship between the topic and the presentation strategy. The intent of this section is to refine the major topics within Acquisition Program Management only to the level necessary to develop a proof of concept prototype program in the subsequent sections. This development strategy is consistent with the off-core activity method presented in the Vee-model concept that states that "off-core activities do not seek a final solution, but rather a demonstration that one is feasible." [Ref. 22: p. 188]

When reviewing the list of candidate topics, the lack of topics related to Acquisition Reform themes is conspicuous. They are not listed as individual topics because, in the words of former Secretary of Defense William Perry:

> These policies are fundamental to all of our acquisition activities essential to clearly defining our performance requirements, establishing affordable life-cycle cost requirements, and working together to develop affordable and executable strategies to resolve issues in a timely manner. [Ref. 30]

Using this principle as a guide, there is no need to include the reform themes as separate topics, instead each of the following topics should incorporate the reform themes into its content.

a) Acquisition Strategy for a Major Defense Acquisition Program (MDAP)

The Acquisition Strategy is related to the Project Cycle described in chapter three and is defined as [Ref. 31: p. 1-1]:

> ...a business and technical management approach designed to achieve program objectives within specified resource constraints. It is the framework for planning, organizing, staffing, coordinating, and leading a program. It provides a master schedule for research, development, test, production, fielding, and other activities essential for program success, and for formulating functional strategies and plans.

This topic will use a Major Defense Acquisition Program for the focus of its content.

b) Acquisition Strategy for a Major Automation Information System (MAIS)

An Acquisition Strategy for an MAIS contains the same conceptual bases for the overall plan for program execution as an MDAP. In fact, the DSMC's Acquisition Strategy Guide [Ref. 31] makes no distinction between developing an Acquisition Strategy for an MDAP or for an MAIS. However, there is enough of a distinction between the two types of programs [Ref. 29] that the Acquisition Strategy for an MAIS does warrant a different emphasis and therefore its own topic.

c) System Engineering Process

The System Engineering Process is used to [Ref. 32: 4.3]:

> ...transform operational needs and requirements into an integrated system design solution through concurrent consideration of all life-cycle needs (i.e., development, manufacturing, test and evaluation, verification, deployment, operations, support, training and disposal). The system Engineering process shall establish a proper balance between performance, risk, cost, and schedule, employing a top-down iterative process of requirements analysis, functional analysis and allocation, design synthesis and verification, and system analysis and control.

The System Engineering Process is closely related to the Technical Aspect of the Project Cycle. In fact, Forsberg, Mooz, and Cotterman define the System Engineering Process as the application of the two subprocesses within their Vee-model: the System Analysis and Design Process and the System Integration and Verification Process. [Ref. 22: p. 37]

d) Defining Critical Design & Capabilities

This topic encompasses the objectives of the original SAFE program and could easily be developed into three or four sequential modules. The overall intent is to allow students to exercise their analytic abilities and knowledge of systems acquisition. The module(s) should allow students to make trade-off decisions concerning the cost, schedule and performance aspects at key decision points. The listing of specific tasks include [Ref. 33]:

-Conduct requirements and trade-off analysis.
-Identify, analyze, and assess program risks.
-Evaluate contractor proposals.
-Develop cost estimates, budget submissions, acquisition strategies, and program baselines.
-Identify critical acquisition management issues and prepare recommendations for decision-makers.

This topic is a compilation of several of the Project Management Elements and the Project Cycle's Budgeting, Business, and Technical aspects.

e) Risk Management

DoD 5000.2-R states that Program Managers need to institute a risk management program for each acquisition program "to identify and control performance, cost, and schedule risks." [Ref. 32: 3.3.2] Risk Management in the DoD parallels the

Risks and Opportunities element of the Project Management Elements and is defined as "All plans and actions taken to identify, assess, mitigate, and continuously track, control, and document program risks." [Ref. 3]

f) Analysis & Control

While Risk Management is the process to identify, assess, track, and mitigate critical items, Analysis and Control activities serve as a basis for measuring progress [Ref. 34: p. 5-3]:

> DoD 5000.2R, Part 4 states that performance metrics must be developed and maintained throughout the process (SE process). These metrics will be used to assess how well the evolving design meets the system requirements...Particular attention will be paid to those metrics that are critical to risk management...The data for each metric will be based on engineering judgment, design analysis, test data (including early test results), and operational data, depending on the status of the design.

Analysis and Control is related to three of the Project Management Elements: Project Control, Project Visibility, and Project Status.

g) Acquisition Logistics

Acquisition Logistics is a topic so broad that it could easily provide material for several modules. It is broad because it is a multi-functional technical management discipline that encompasses design, development, test, production, fielding, sustainment, and improvement modifications that achieve the user's peacetime and wartime readiness requirements [Ref. 35: 4-1]. DoD Regulation 5000.2-R mandates that [Ref. 32: 4.3.3]:

> The PM shall conduct acquisition logistics management activities throughout the system development to ensure the design and acquisition of systems that can be cost-effectively supported and to ensure that these systems are provided to the user with the necessary support infrastructure for achieving the user's peacetime and wartime readiness requirements.

Because Acquisition Logistics is so broad in scope, it can be related to several of the concepts and elements in the Project cycle and the Project Management Elements as it is applied throughout system development as mandated by the DoD.

h) Contracting & Contract Management

There are a myriad of contract types. The specific type is selected to provide for a reasonable sharing of risk for the performance of the contract. Because of its ability to balance the risk, the selection of the most appropriate type of contract and fee for the particular procurement is essential. [Ref. 36: p. 1-1]

This topic corresponds to the Source Selection Phase of the Implementation Period from the Project Cycle.

i) Budgeting

Budgeting involves the short and long range planning and execution of resources. The improper application of this topic means that there may be no program [Ref. 32: 2.5.2]:

> No acquisition program shall be approved to proceed beyond program initiation unless sufficient resources, including manpower, are programmed in the most recently approved FYDP, or will be programmed in the next Program Objective Memorandum (POM), Budget Estimate Submission (BES), or President's Budget (PB).

Budgeting in acquisition relates to the budgeting aspect of the Project Cycle.

j) Test & Evaluation

Test and evaluation (T&E) in a defense system's development and acquisition program helps to identify the areas of risk to be reduced or eliminated [Ref. 37: p. 1-1]:

> Test and evaluation programs shall be structured to provide essential information to decision-makers, verify attainment of technical performance parameters, and to determine whether systems are operationally effective, suitable, and survivable for intended use.

This topic corresponds to the Verification Phase of the Implementation Period from the Project Cycle.

k) Production & Fielding

During this phase of the DoD acquisition process, the Program Manager must ensure the system meets the user's needs while being sensitive to the impact of the manufacturing decisions on production costs. Through careful selection from the manufacturing alternatives, the PM can achieve significant cost savings. The key activities for this phase include manufacturing, contract monitoring, and acceptance testing. [Ref. 38: p. 3-11]

This topic corresponds to the Production Phase of the Project Cycle.

l) Work Breakdown Structure & Earned Value

The DoD regulation 5000.2-R requires Program Managers to establish a program work breakdown structure (WBS) to provide a framework for program and technical planning, cost estimating, resource allocations, performance measurements, and status reporting [Ref. 32: 4.4.2].

The WBS corresponds to the Project Planning element and EV corresponds to the Project Status element of the Project Management Elements.

m) Software Management

Software Managers need to be able to "define objectives, to create, evaluate, and select alternatives for reaching them, and to control the implementation of selected alternatives". [Ref. 39] These can be difficult tasks because of the intangible nature of software. Software estimation is a key activity in planning and managing software intensive programs. Software cost and schedule estimation is usually implemented using models that quantitatively relate measures or projections of software size, development and maintenance effort, schedule, and quality through the use of an integrated performance or efficiency measure. [Ref. 40]

Software Management is not limited to any single portion of the project management principles from chapter three; instead, one would use all the principles while emphasizing the software relevant elements like Project Control, to effectively manage a software project.

n) People Factors

This item was not offered in any of the preexisting courses. However, through the research and interviews it surfaced as a necessary topic. People skills are required for a manager when building or interacting with the project team and for communicating with the stakeholders for a project. This topic is related to the Teamwork and Leadership elements.

2. Strategies

Because of the varied student backgrounds, class objectives, and instructor preferences, there emerged no single strategy appropriate for presenting the modules. Fortunately, a flexible, modular architecture as described in a previous section will allow an instructor to use whatever strategy he or she determines is the most appropriate to reach the course objectives.

The research indicated that there were several strategies to presenting the topics that seemed to be viable options for meeting course objectives.

a) Chronological by Phase

Chronological by phase is a common approach to teaching Program Management. Most of the consortium schools teaching Acquisition Program Management used this method in at least one of their courses. This approach takes the student through the acquisition phases in a sequential manner, introducing each topic as it appears in chronological order. For example, the first topic may be a Requirements Generation related topic followed by a Concept Exploration related topic.

b) Concept Centric

A concept centric strategy places the importance of the topic or concept over the need for a chronological ordering of their appearance. Using this strategy, the topics are more likely to appear as stand alone material and not lead into the next module. For example, a topic concerning logistics may follow a topic involving test and evaluation.

c) Parallel Comparison of MDAP vs. MAIS

The comparison strategy emphasizes both types of program through out the acquisition cycle to provide an appreciation for their differences. Modules designed for this strategy would probably be sequential in nature and the objectives would focus on highlighting the differences between the management of these programs.

d) Systems Engineering Centric

A systems engineering centric approach provides students a view of the acquisition process through modules that underscore the role of the systems engineering process.

e) Logistics Centric

A logistics centric approach uses the same concept as the systems engineering centric strategy except it features the acquisition logistic perspective to the acquisition systems management process.

f) Hybrid Approach

A hybrid approach mixes elements from the preceding strategies. This style may involve any number of the aforementioned approaches combined to present an optimized collection of strategies for one course. An example of this strategy would be to use a parallel comparison for the first two modules, a chronological by phase for the next few modules, and then a few concept centric for the final modules.

D. CHAPTER SUMMARY

Because it is impractical for a single static program to address all the strategies and topics required by the users, the NPS ATAPMS needs to accommodate many interchangeable modules and must scale to the user's needs. Additionally, to be viable for

the future and to comply with the intent of the Defense Reform Initiative, the program must also incorporate the Advanced Distance Learning precepts. Table 4-1 provides a comprehensive summary of the recommendations for the structure, strategies, and topics for the application of an ATAPMS at the NPS presented in this chapter.

This chapter used the Vee-model concept to develop baseline recommendations for the structure, and to propose content for off-core study. The next chapter will continue this method by using a subset of the proposed content to develop a prototype of an ATAPMS for the NPS.

Structure	Content	Strategies
-Use a capstone style approach to the content -Accommodate at least 10 weekly topic modules -Be capable of presenting well developed thought-provoking scenarios and questions -Ensure modular architecture for scalability and a plug and play capability -Be IMS compliant -Ensure Accessibility -Ensure Durability -Ensure Re-usability -Ensure Cost effectiveness	-Acquisition Strategy for a Major Defense Acquisition Program (MDAP) -Acquisition Strategy for a Major Automation Information System (MAIS) -System Engineering Process -Defining Critical Design & Capabilities -Analysis & Control -Risk Management -Acquisition Logistics -Contracting & Contract Management -Budgeting -Test & Evaluation -Production & Fielding -Work Breakdown Structure & Earned Value -Software Management -People Factors	-Chronological by Phase -Concept Centric -Systems Engineering Centric -Logistics Centric -Hybrid Approach

Table 4-1. Summary Table.

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V. DESIGN OF THE PROGRAM MANAGEMENT TRAINING TOOL

A. INTRODUCTION

This chapter continues the Vee-model off-core study concept by exploring one possible approach to devising an ATAPMS application that meets the requirements specified in Chapter Four. Specifically, this chapter enumerates strategies for acquiring the software required to support an ATAPMS and then uses one of those strategies for demonstrating the construction of a notional module.

B. DEVELOPMENT STRATEGIES

There are two realistic approaches to developing an ATAPMS program that meet the top-level specifications defined in the previous chapter: develop new software code or use commercial based authoring tools.

A third option, modifying existing software by combining applications such as Microsoft Project Manager and Microsoft Access using a web based interface like Cold Fusion, is not reasonably feasible. Adding additional modules in a "plug and play" fashion that incorporates the IMS requirements to applications cobbled together is as involved as writing new software code. Further, software licensing management, seemingly random changing of application versions, and lack of vendor support because of modifications made to their products, increases the undesirability of this option.

The decision between the two remaining options for the best approach depends on several factors. In the case of the NPS, the most applicable factors according to the interviews were:

-Ease of use: The ability for an instructor to use the software to create or modify modules.

-Applicability: The capability of the program to help the instructor meet his or her learning objectives.
-Cost: The amount of resources measured in time and money required to create modules.
-Maintainability: The ability to modify, correct faults, improve performance, or other attributes, or adapt to a changed environment.
-Time: The amount of time required to field the initial and subsequent modules.

1. Developing New Code

The first method is developing the application using completely new software code. This method has one strong benefit. An application designed from the beginning with the specifications and requirements of the NPS would optimize the "applicability" criterion, and as a result be highly tailored to the needs of the acquisition program management instructors.

According to an NPS software instructor interviewed, however, the disadvantages to building an application to meet the top-level specifications identified for an ATAPMS by writing new code are numerous. Time required for development of the initial and subsequent modules is a significant factor for this option. Also, to obtain the ease of use and applicability desired, the cost for building a proprietary program will be much higher than purchasing a commercial product.

Maintenance requirements add another heavy cost burden to the builder as well. For example, if the ATAPMS were programmed in JAVA, a language that adheres to the top-level specifications enumerated in the previous chapter, all content authors needing to create or modify existing or subsequent modules must adhere to the same standards used to create the original program. While still feasible, this restriction makes the concept of a

"plug and play" program harder to accomplish, especially as institutional knowledge of the standards for the original program declines over time.

Additionally, the ability for the average instructor to create and employ a module becomes highly unlikely in this scenario. Because of the requirement to write code specific to the original program, modifications to existing modules or the creation of additional modules will probably require the efforts of an experienced programmer.

Finally, the adherence of the software to the IMS standards adds a complex and costly dimension to the generation of the software code. Not only will the modules require a programmer's skill to write, but that programmer must also be familiar with the nuances of the IMS standards.

2. Commercial Based Software

The second option for developing the ATAPMS application is to use commercially available authoring products. Authoring systems are software applications that allow the developer to create a multimedia education product without having to write software code. Each authoring system has its strengths: some work best with databases, computer-based instruction, or just as general all-purpose applications. [Ref. 41]

The commercial authoring systems have one major disadvantage, but they also have several distinct advantages. The disadvantage to using a commercial product is the "applicability" factor. Because the functionality of a commercial product is predetermined, there may be features that an instructor needs that are not available. This disadvantage caused Indiana University to choose creating its online course management system by writing new code instead of adapting a commercially available application

[Ref. 42]. Although the Indiana University's requirements are different from the NPS requirements, this example illustrates the importance of the "applicability" issue.

The advantages to using commercial authoring tools that allow one to create custom courseware are numerous. The first advantages are cost and time. The average cost for a commercial authoring system typically range from $1,000.00 to $5,000.00 [Ref. 41], which according to one NPS software instructor is several times less than writing new software code for a project like an ATAPMS. That cost differentiation widens considerably with the need for new modules and support for the existing software. Also, the time needed to develop the initial application or subsequent modules is measured in days or hours, not months. This advantage is especially significant for instructors who need to make last minute modifications to their courses.

The third advantage is maintainability. The commercial vendors have an inherent need to keep pace with the evolving technologies in a cost effective and timely manner. This condition works to the user's favor because it shifts the burden for maintaining the software code from the user to the vendor. Because the vendor has a comparative advantage in maintaining the software, it will cost less for the user to adapt the existing software to a changed environment.

A fourth advantage is the ability for the average instructor to generate his or her own modules without the need for programming expertise. The web based authoring tools that meet the ATAPMS top-level specifications use a graphical user interface that allow the user to create a multimedia product without having to write software code.

A final advantage is the capability for the NPS to eventually integrate the use of an on-line management software system to organize the delivery of the ATAPMS

courseware. While this criterion was not mentioned by any of the instructors interviewed, the research indicates that given sufficient growth in the use of an ATAPMS, an on-line management tool may be essential to successfully scaling the ATAPMS to a wider audience. If the use of the ATAPMS grows from a once a week resident laboratory exercise to a distance learning course supplement, instructors may need such a tool to help administer the ATAPMS and other related courseware. The management system would assist in administering the ATAPMS by providing instructors the ability to structure learning groups, add users, control the course availability, and obtain detailed evaluation reports on student performance. [Ref. 43]

The research demonstrates that to meet the initial needs of the NPS, investing in a commercial authoring tool to develop an ATAPMS has an advantage in many areas over designing a proprietary application (Table 5-1).

	Ease of Use	Applicability	Time	Cost	Maintainability	Management System
Commercial Authoring Tool	+	–	+	+	+	+
Proprietary Application	+	+	–	–	–	–

Table 5-1. Option Comparison.

C. CONSTRUCTING THE MODULES

This section uses a subset of the proposed content from the previous chapter and a commercial authoring tool to illustrate one way of developing an ATAPMS. The following off-core study uses the "hybrid" approach, mixing the elements from the preceding types of strategies documented in Chapter Four to present the topic modules. In the planning phase, the titles of 10 modules are listed to illustrate a notional course load

for a quarter. From these 10 topics, four modules are presented in a high level format to demonstrate their learning points. In the layout phase, one of these modules is further developed using a commercial authoring application.

1. Planning

Table 5-2 depicts the 10 modules selected from the topic section of the previous chapter.

Week 1	Week 2	Week 3	Week 4	Week 5
Acquisition Strategy (MDAP)	Acquisition Strategy (MAIS)	System Engineering Process	Define Critical Design & Capabilities I	Define Critical Design & Capabilities II
Week 6	Week 7	Week 8	Week 9	Week 10
Define Critical Design & Capabilities III	Risk Management	Analysis & Control	Acquisition Logistics	Contracting & Contract Management

Table 5-2. Notional Course Load.

To continue the planning process, the learning objectives for modules 1,2,7 and 8 are described using the U.S. Army's "Task, Condition, Standards" method (Table 5-3), followed by a "design approach" (Table 5-4) description for constructing the modules. The task defines a measurable activity for the students to perform [Ref. 44]. The conditions explain the circumstances and environment in which the task is to be performed. The standard describes the minimum acceptable proficiency required in the performance of the particular training task. Finally, the design approach description provides general guidance for features and functionality required from the software to allow the module to accomplish the intended learning objectives.

Module 1 Acquisition Strategy (MDAP)	Module 2 Acquisition Strategy (MAIS)	Module 7 Risk Management	Module 8 Analysis and Control
TASK: Develop an Acquisition strategy for a Major Defense Acquisition Program.	TASK: Develop an Acquisition strategy for a Major Acquisition Information System.	TASK: Evaluate a program scenario and determine the areas of risk, prioritize the selected areas and devise a risk mitigation strategy that includes metrics.	TASK: Employ metrics developed during Risk Management Module and interpret results from a visual display of the submitted metrics.
CONDITION: Given a Mission Needs Statement, an Acquisition Decision Memorandum, Progress Report (CE Phase Studies), Performance Requirements, and a general scenario.	CONDITION: Given a Mission Needs Statement, an Acquisition Decision Memorandum, Progress Report (CE Phase Studies), Performance Requirements, and a general scenario.	CONDITION: Given a program scenario with sufficient cost and probability of occurrence details, risk reduction strategies and a risk reduction budget.	CONDITION: Given a program scenario that provides quantifiable data reflecting a snapshot in time for a project status.
STANDARD: Student teams must determine an appropriate Acquisition strategy for an MDAP. They must adequately address the following elements in their strategy: -basic strategy (in terms of milestones, phases, technical reviews, contract award dates and other key events) -Streamlining, -Competition -Contract types -Proposed exit criteria for the next phase -Budgeting	STANDARD: Student teams must determine an appropriate Acquisition strategy for an MAIS. They must adequately address the following elements in their strategy: -basic strategy (in terms of milestones, phases, technical reviews, contract award dates and other key events) -Streamlining, -Competition -Contract types -Proposed exit criteria for the next phase -Budgeting	STANDARD: Student teams must demonstrate a working level of knowledge of Risk Management. Teams should be able to analyze a scenario and identify the areas of risk and produce a Risk Management strategy (to include a quantifiable measure of risk for each event). Teams will perform a cost/benefit analysis. Teams will also identify the metrics to be included as reportable items in the contract.	STANDARD: Student teams must analyze given program data and extract the appropriate information needed for input to a mechanism that will provide a visual read-out of the submitted metrics. Students must evaluate the visual output and provide mid-level management analysis and recommendations to senior level management.

Table 5-3. Sample Learning Objectives.

This design approach uses generally accepted design principles that are already included as a feature in several authoring tools. For example, the following design approach includes the need for interactivity and user friendly navigation.

Module 1 Acquisition Strategy (MDAP)	Module 2 Acquisition Strategy (MAIS)	Module 7 Risk Management	Module 8 Analysis and Control
Design Approach: (a) Make hyperlinks available on the first page along with instructions for completing the module. Links correspond to the read-ahead (documents describing the scenario for this module, and the instructions for fulfilling this module's requirements) and the Defense Acquisition DeskBook Online. (b) There are six pages with blank window backgrounds, each displaying 24 evenly spaced vertical lines delineating the months. (c) Movable bar and triangle shaped icons representing the various tasks possible to perform during that phase (e.g. conduct Analysis of Alternatives, etc.) are available at the bottom of the window for students to "drag and drop" in the position predetermined by their review of the scenario.	Design Approach: (a) Make hyperlinks available on the first page along with instructions for completing the module. Links correspond to the read-ahead (documents describing the scenario for this module, and the instructions for fulfilling this module's requirements) and the Defense Acquisition DeskBook Online. (b) There are six pages with blank window backgrounds, each displaying 24 evenly spaced vertical lines delineating the months. (c) Movable bar and triangle shaped icons representing the various tasks possible to perform during that phase (e.g. conduct Analysis of Alternatives, etc.) are available at the bottom of the window for students to "drag and drop" in the position predetermined by their review of the scenario.	Design Approach: (a) Make hyperlinks available on the first page along with instructions for completing the module. Links correspond to the read-ahead (documents describing the scenario for this module, and the instructions for fulfilling this module's requirements) and the Defense Acquisition DeskBook Online. (b) The next page provides a table with text and number capture windows that students fill in with event name, probability, and impact of occurrence. (c) The next page(s) presents the user with a calculated risk exposure figure and requires students to prioritize risk reduction measures based on a cost benefit analysis.	Design Approach: (a) Make hyperlinks available on the first page along with instructions for completing the module. Links correspond to the read-ahead (documents describing the scenario for this module, and the instructions for fulfilling this module's requirements) and the Defense Acquisition DeskBook Online. (b) The next several pages allow students to input the raw data gleaned from the scenario for the relevant metrics identified during Module 7. (c) The next page provides a display using graphs, charts or other appropriate visual display of the data entered.

Table 5-4. Design Approach.

Module 1 Acquisition Strategy (MDAP)	Module 2 Acquisition Strategy (MAIS)	Module 7 Risk Management	Module 8 Analysis and Control
(d) The next page prompts the user to enter a written summary that characterizes their overall acquisition strategy. (e) Follow on pages require the students to answer questions using text capture boxes addressing their approach to selecting contract types, CAIV considerations, budgeting breakdown, and IPT implementation as they relate to an MDAP program.	(d) The next page prompts the user to enter a written summary that characterizes their overall acquisition strategy and how that strategy differs from an MDAP strategy. (e) Follow on pages require the students to answer questions using text capture boxes addressing their approach to selecting contract types, CAIV considerations, budgeting breakdown, and IPT implementation as they relate to an MAIS program.	(d) Follow-on page(s) query students for metrics to include as reportable items in the contract to monitor risk factors. (e) Follow on pages require the students to answer questions using text capture boxes addressing their overall risk Management Strategy.	(d) The next page(s) provides boxes arranged in an ordinal sequence to allow students to express their qualitative opinion about the status of a program via checkmarks. (e) Follow on page(s) use text capture boxes requiring the students to provide assessment of overall program status as they interpret it from the displayed data and to make any recommendation for senior management concerning necessary corrective actions.

Table 5-4. Design Approach (continued).

2. Layout

Having demonstrated a method of conducting the planning phase, the next step is to use one of the preceding module plans and develop an ATAPMS module using a commercial authoring tool. This section illustrates how an ATAPMS module would look from the developer and the user perspective.

The authoring tool used to demonstrate this off-core study is "ToolBook II, Assistant 7" distributed by Asymetrix Learning Systems. While there are commercially available authoring tools, such as MacroMedia's "Authorware", that contain the functionality required for an ATAPMS, ToolBook II is not among them. ToolBook II

does not possess the text capture and retrieval functionality necessary to facilitate a qualitative review of the user's input. Therefore, ToolBook II is used in this section only to generate the figures needed to illustrate the user's view of a module that appears to contain the functionality desirable for an ATAPMS.

a) Module Posting

Once the module is created, ToolBook II provides the option to "Import to HTML": a feature that automatically packages the module in a directory ready for publication on a website (Figure 5-1). Within each directory are all of the files necessary for posting the module on a web server (Figure 5-2). Because all of these files are automatically generated by the authoring tool with the execution of one command, an instructor acting as developer only needs to be proficient with developing the actual content of the module, and not the secondary task of preparing the module to be accessed from a web server.

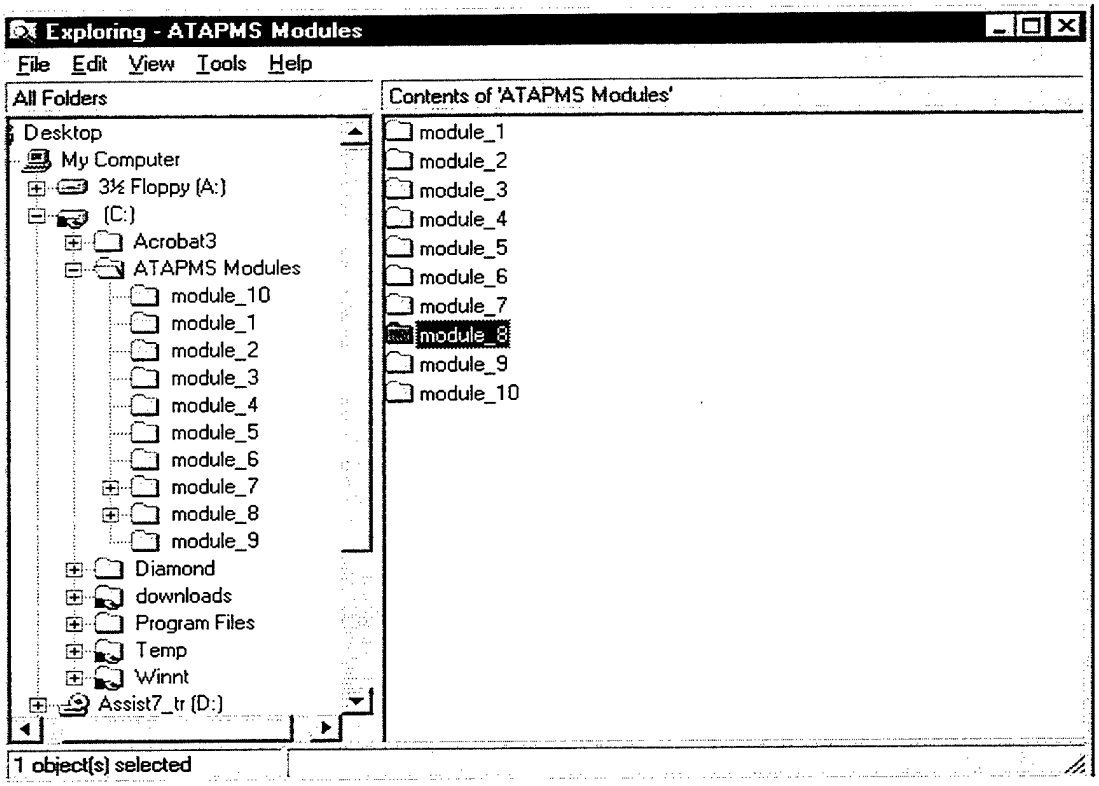

Figure 5-1. Web Enabled Directories.

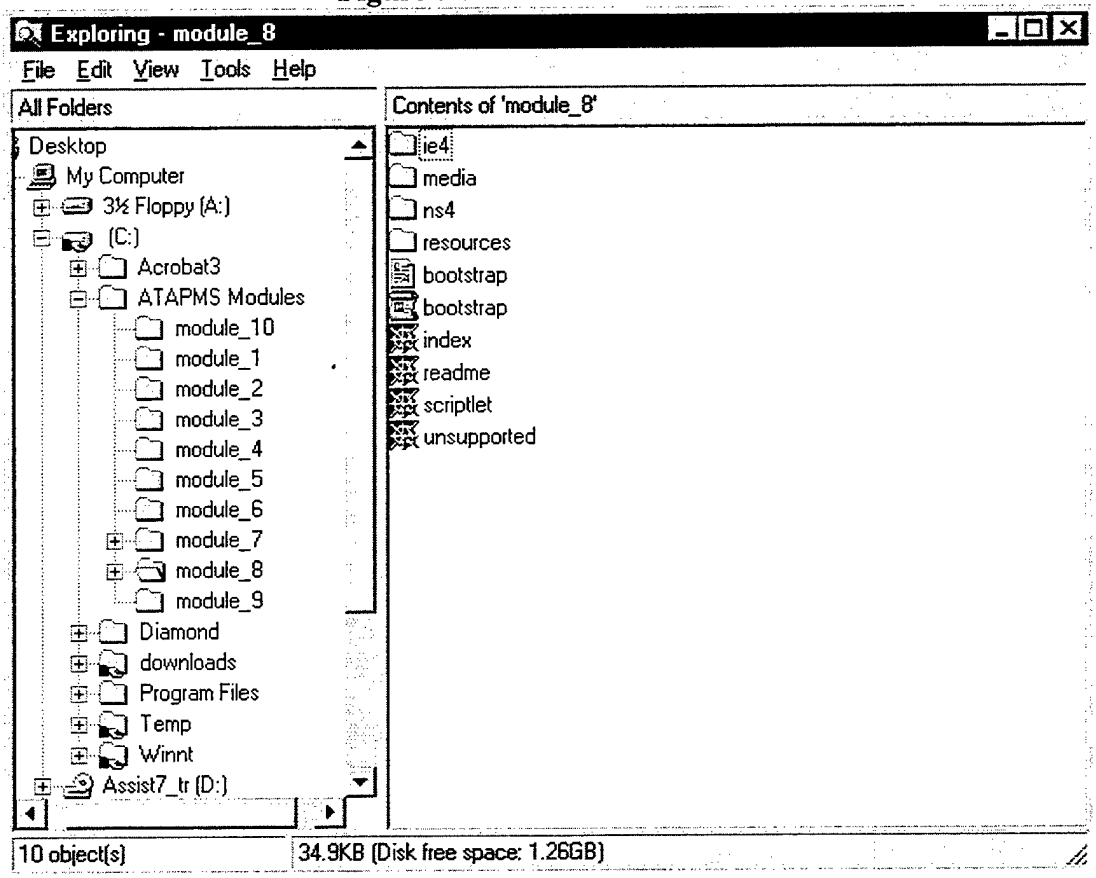

Figure 5-2. Inside Module 8's Directory.

b) Module Presentation

After loading the module directories onto a web server, a simple web page is all that is needed to provide a link to each of the scenarios and module directories. The instructor can use this web site as a "home page" for the courseware, allowing students convenient access to the scenarios and modules (Figure 5-3). Students can access this site from any location on the Internet well in advance in order to prepare for the scheduled lab.

This schema supports the plug and play concept by using an easily reconfigurable interface between the application modules and the students. Any changes made by the instructor or application manager to the modules, their directory structures, or the scenarios, are transparent to the users. Any additions made to the courseware can be easily and quickly accommodated by the web interface.

c) Module Example

The following module example demonstrates one method of designing a desirable learning experience for a user based on the preceding "Sample Learning Objectives" and "Design Approach" presented in Table 5-3 and 5-4 for "Module 8: Analysis and Control". Prior to downloading the module, the user would first download and review a case scenario (e.g. "Scenario 8" shown in Figure 5-3) that is also linked to course home page. Once familiar with the scenario, the user can return to the home page and download the actual module (e.g. "Lab 8 Module" shown in Figure 5-3).

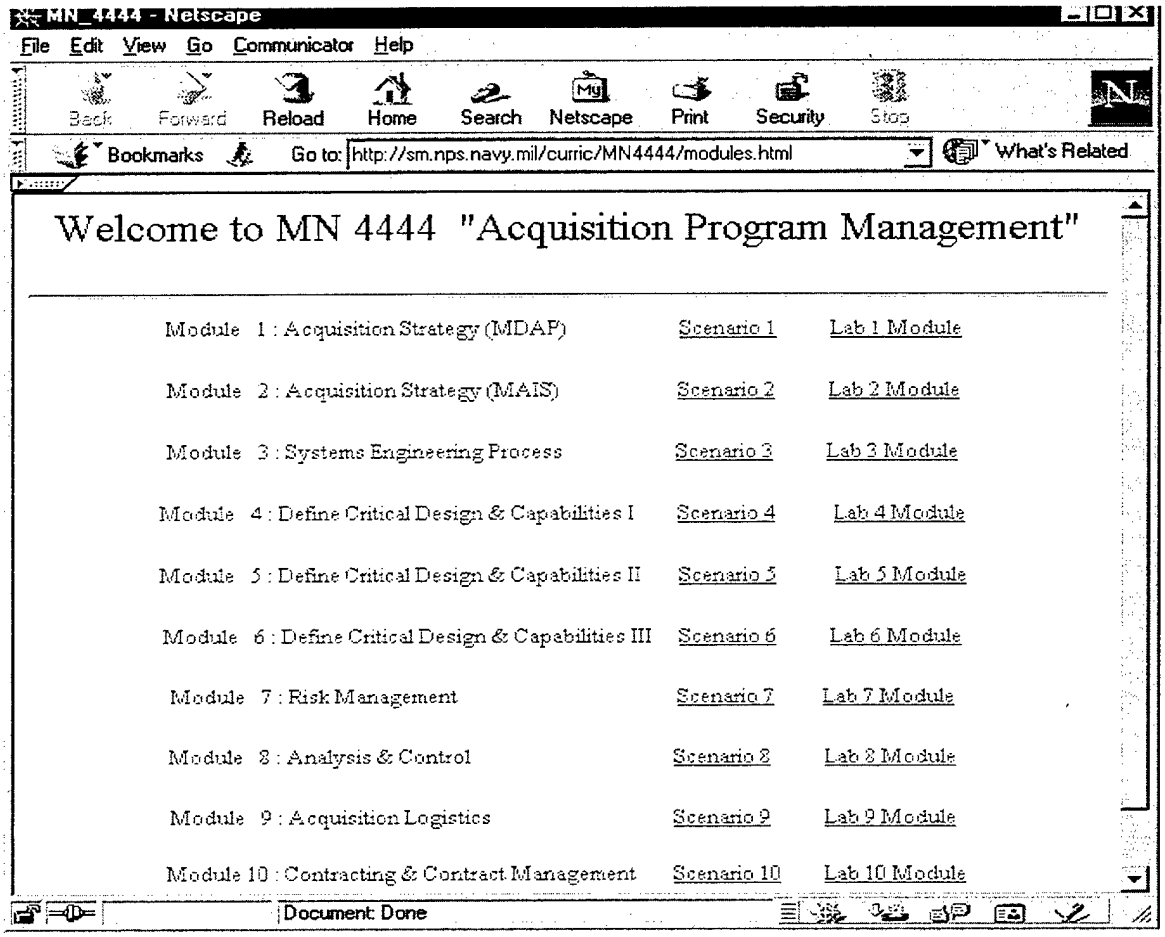

Figure 5-3. Web Site Used as a "Home Page."

Figure 5-4 provides an example module front page as viewed by the user after downloading it from the home page. In this example, the module fosters an integrative capstone approach to the lesson and therefore is designed be used by student teams. Accordingly, the users would enter their "team identification" so the instructor could distinguish between the various teams' module outputs. There is also an administrative information and HTTP hyper-link to the scenario read-ahead and the Department of Defense Acquisition DeskBook web site.

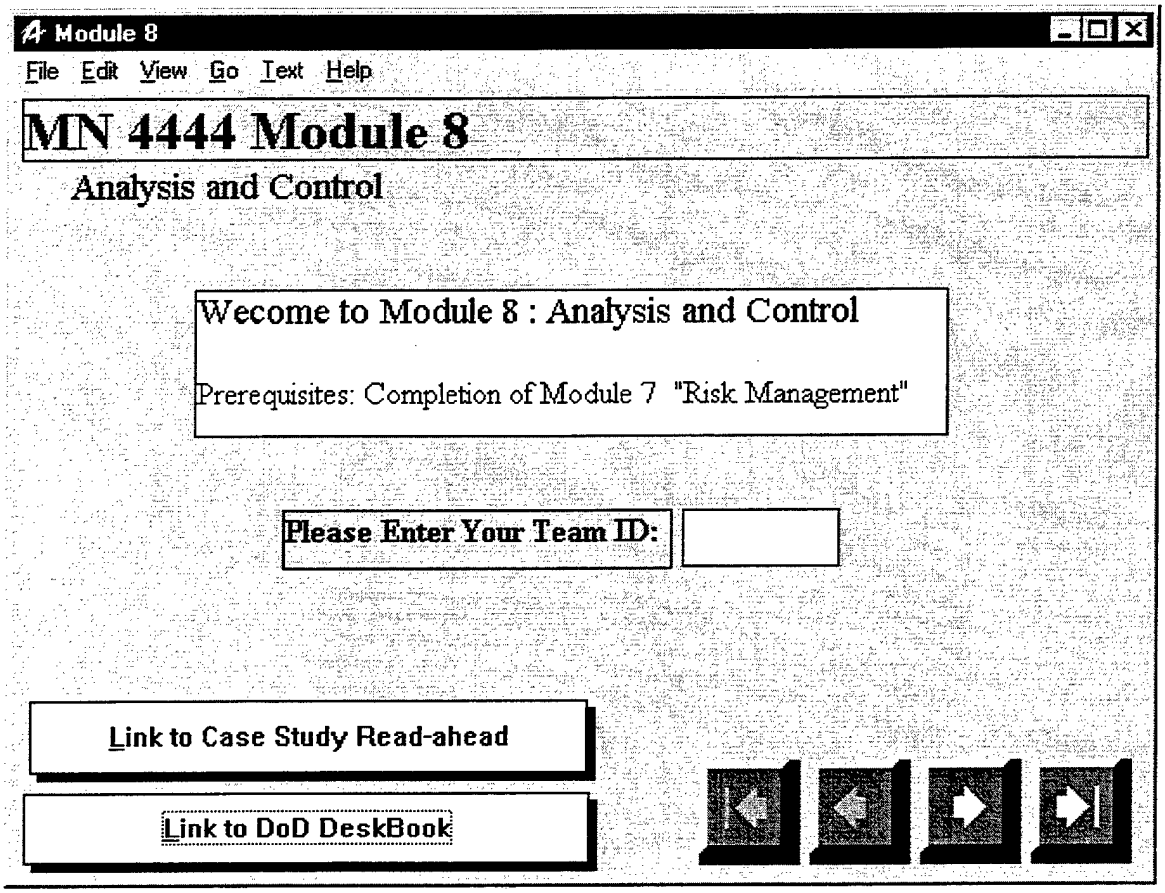

Figure 5-4. Module Front Page.

The next page provides an example of requiring students to extract the appropriate information to demonstrate the understanding of a scenario. The module page presents a query to the user. The previously viewed scenario concerning the application of software metrics provided the user with the quantitative software metrics data required to answer the query. Figure 5-5 shows the student's input to those queries based on their understanding of the scenario. Although it is not shown in this example, there would be as many subsequent pages as necessary to capture the relevant metrics.

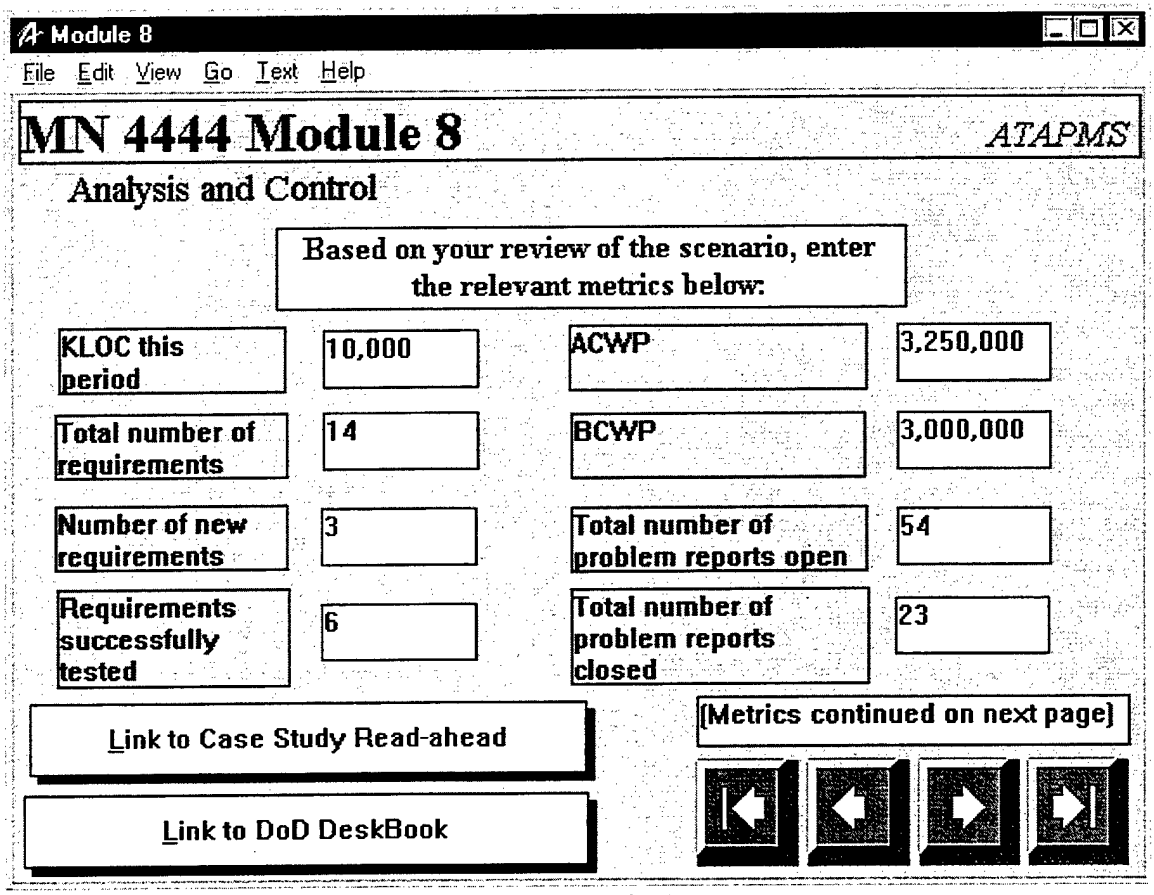

Figure 5-5. Numerical Input.

After requiring the students to demonstrate an ability to distill factual material from the given scenario, the following pages prompt them to provide qualitative interpretations of the factual data. The next few pages of the module query the students for their assessment of the program's status based only on the numerical data (Figure 5-6). The students are prompted to evaluate the status of the various components (e.g. "requirements" or "design") of the scenario program based only on the reading of the scenario. In this example, the students will check the block to provide their assessment. Again, although it is not shown in this example, there would be as many subsequent pages as necessary to capture the assessment of all the desired areas.

After the students complete their assessment, the follow-on page of the module then provides a graphic that transforms the numerical data into a visual display (Figure 5-7). Next, to help illustrate the usefulness of comprehensive graphics, the module allows the students to reevaluate the previously answered questions (Figure 5-8). The intent of this comparison is to measure the difference in the student's perception of the data based on numerical versus a visual reference and demonstrate the advantage of a graphical presentation for managers.

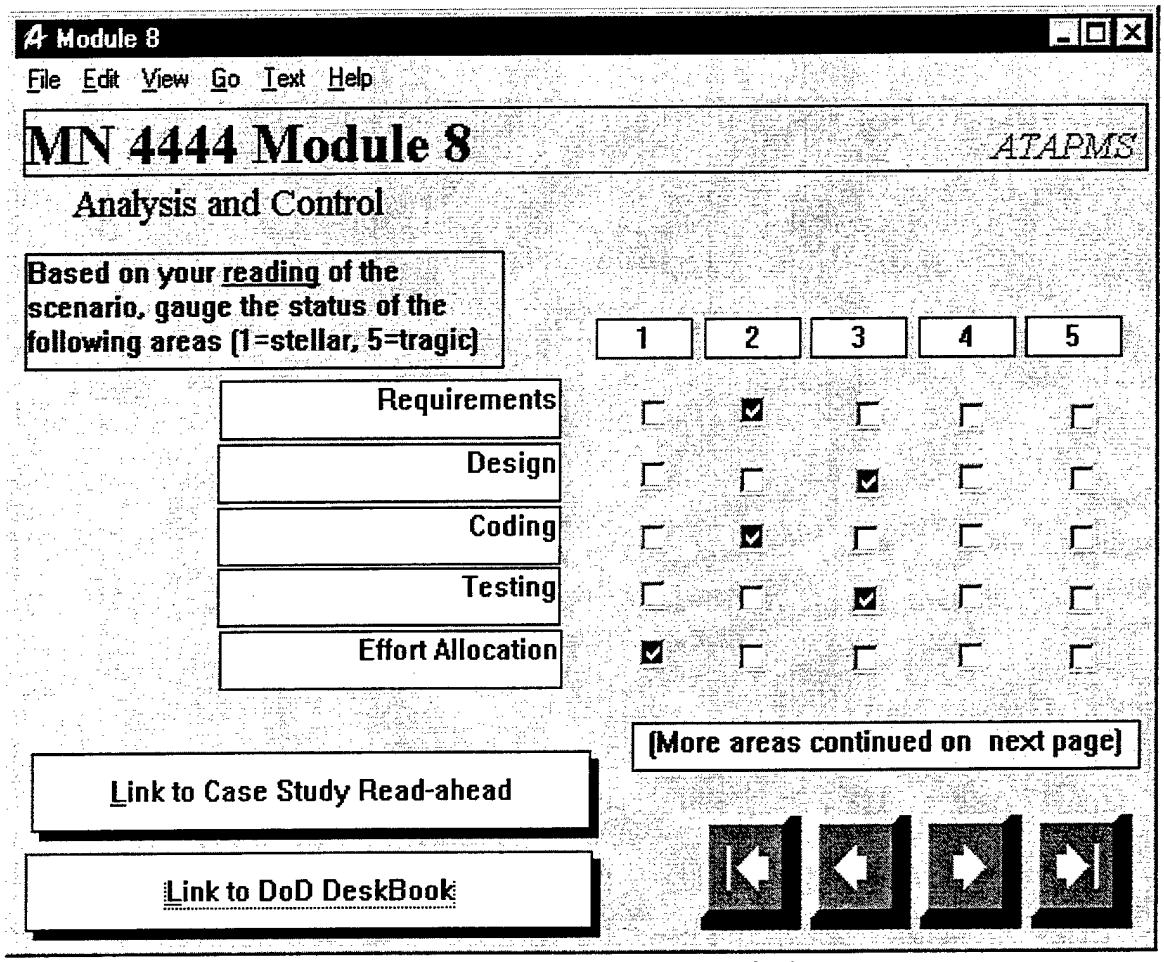

Figure 5-6. Query Based on Numerical Data.

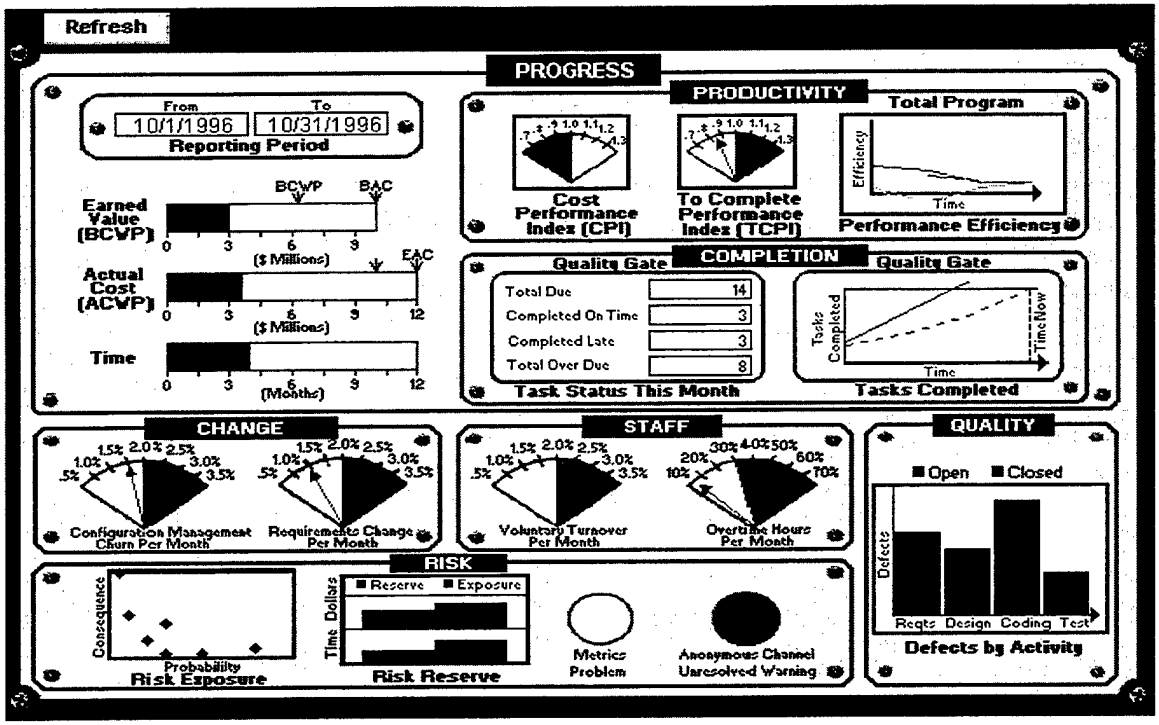

Figure 5-7 From [Ref. 45]. Visual Display of Data.

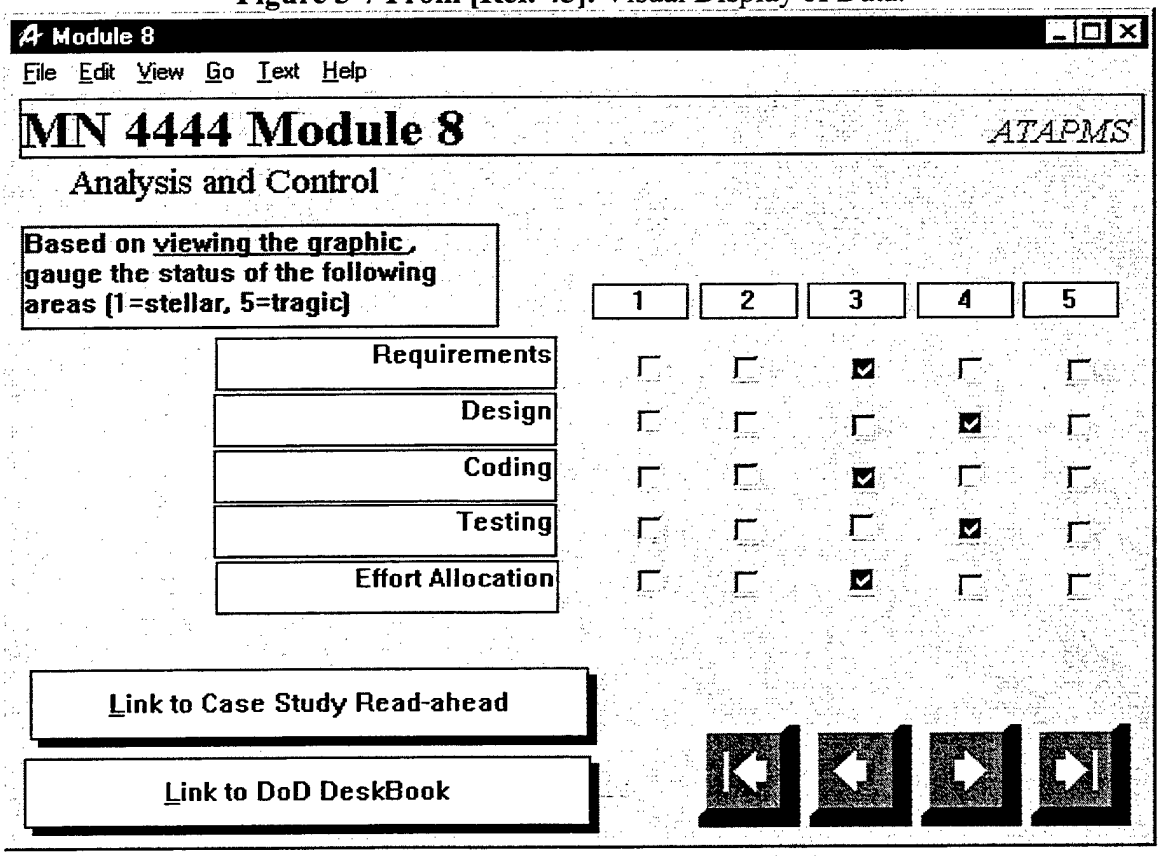

Figure 5-8. Query Based on Visual Display.

The final pages of this module require the students to elaborate on their overall assessment of the program status. Figure 5-9 requires the students to type their evaluation of the program's "health" into a text capture box. Figure 5-10 requires the students to type into a text capture box their recommendations for corrective actions. This feedback allows an instructor to measure the student's comprehension of a program's status.

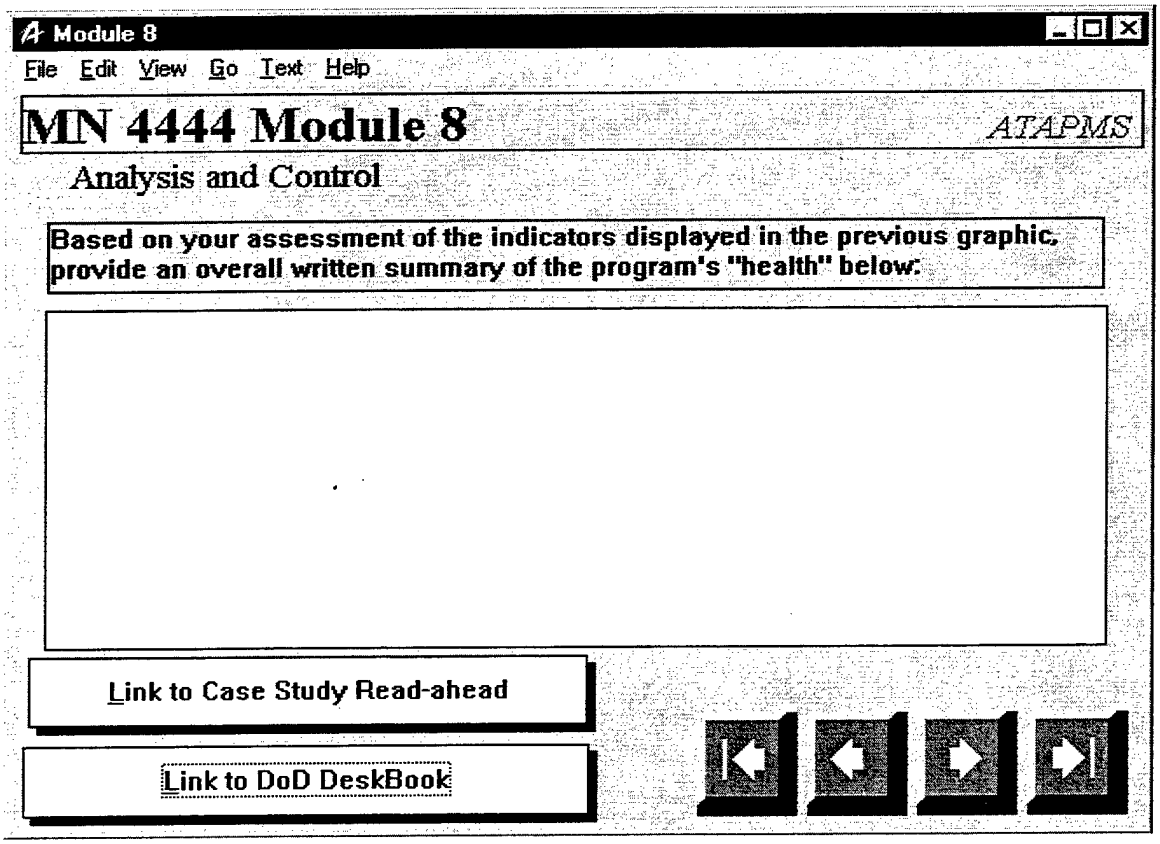

Figure 5-9. Overall Summary of a Program's Health.

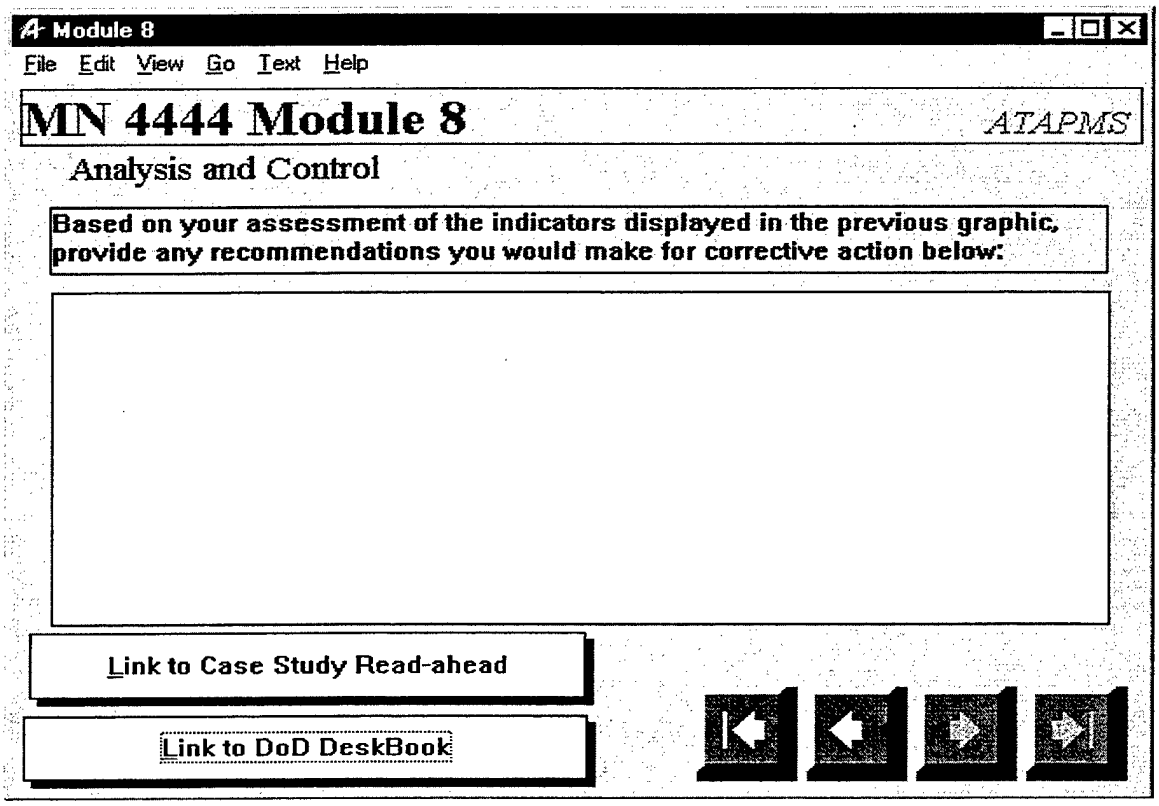

Figure 5-10. Recommendation for Corrective Action.

d) Module Output

The format of a module's output varies with the different commercial authoring tools. A review of several of the tools available shows that the feedback options have a wide range. Some authoring tools provide an instructor with only a simple numerical score based on the user's performance. Others offer the instructor the capability to view the user's score and the specific answers chosen for the questions presented. The most useful authoring tools, and the only category that meets the requirements for an ATAPMS, provide the capability to export all the information entered by the user.

The ability to capture and retrieve all of the user's input is essential. This feature is necessary to allow an instructor to perform a qualitative review of essay type

answers. The capture and retrieval capability is also necessary for writing numerical input to a database and then developing dynamic graphics from that information.

D. CHAPTER SUMMARY

The most practical option for building the ATAPMS modules is through the use of commercial based authoring tools. These tools have many advantages over developing new code: developing new modules or adjusting existing modules is easier and costs less, requires less time, and are easier to maintain. Even though authoring tools are the most practical option, care must be taken to select a tool that provides the applicable features required by an ATAPMS such as the capability to capture and retrieve the content of a user's session.

VI. CONCLUSION

A. CONCLUSIONS

The DoD has identified the education and training of the acquisition workforce as a strategy to help make the acquisition system more effective and efficient. As a result, the DOD established the DAU to provide the required education and training. More recently, EO 13111 and the DRI have presented a mandate for the DoD to find ways to use technology to further this goal. In concert with this mandate, the DoD's ADL initiative will provide the added reach and the decreased cost of education and training through the creation of industry-wide standards for educational software.

Even though the DAU is responding to this mandate and using technology to provide interactive distance learning courses, there is one type of course not yet offered. There are currently no automated courses that include a feature desired by several instructors at the NPS: the capability to allow instructors to qualitatively assess a student's work.

B. RECOMMENDATIONS

To help satisfy this need, this thesis developed the top-level requirements and illustrated a notional Acquisition Program Management course for an ATAPMS model tailored to the needs of instructors at the NPS. Most importantly, ATAPMS needs to accommodate many interchangeable modules and must scale to the user's needs. Additionally, the program must also incorporate the Advanced Distance Learning precepts. Table 6-1 provides a comprehensive summary of the recommendations for the structure, strategies, and topics for the application of an ATAPMS at the NPS.

Structure	Content	Strategies
-Use a capstone style approach to the content -Accommodate at least 10 weekly topic modules -Be capable of presenting well developed thought-provoking scenarios and questions -Ensure modular architecture for scalability and a plug and play capability -Be IMS compliant -Ensure Accessibility -Ensure Durability -Ensure Re-usability -Ensure Cost effectiveness	-Acquisition Strategy for a Major Defense Acquisition Program (MDAP) -Acquisition Strategy for a Major Automation Information System (MAIS) -System Engineering Process -Defining Critical Design & Capabilities -Analysis & Control -Risk Management -Acquisition Logistics -Contracting & Contract Management -Budgeting -Test & Evaluation -Production & Fielding -Work Breakdown Structure & Earned Value -Software Management -People Factors	-Chronological by Phase -Concept Centric -Systems Engineering Centric -Logistics Centric -Hybrid Approach

Table 6-1. Summary Table.

The most practical option for building the ATAPMS modules is through the use of commercial based authoring tools. However, care must be taken to select a tool that provides the applicable features required by an ATAPMS as listed in the "Structure" column in table 6-1. Additionally, any tool chosen to build ATAPMS modules must be capable of capturing and retrieving the content of a user's session to enable the dynamic generation of graphics and an instructors qualitative assessment of a student's work.

C. RECOMMENDATIONS FOR FURTHER RESEARCH

There are three topics that require further research. The first topic is the comparison of authoring tools to determine which tool best matches the requirements of the instructors at the NPS as well as the DAU. The second related, but distinct subject, is evaluating the need for a system to provide management for the users and the ATAPMS modules. The third and final topic involves developing a working prototype for a course.

While there are several authoring tools available, a careful review is required to find an appropriate match for the individual consortium school. Because it is possible to

find more than one product that meet the requirements outlined in this thesis, further research is needed to evaluate the candidate tools' strengths and weaknesses against each other in conjunction with the needs of the DAU consortium school.

In addition to an authoring tool, further research should also include the selection of a management tool. Management tools are used for the "command and control" of courses and students. They provide a method of centrally controlling the various learning activities, including course delivery, access, collaboration, and performance tracking.

Most authoring tools can operate independent of their associated management applications. However, the majority of tools encountered during the research of this thesis had a corresponding management application that was more expensive than its associated authoring tool. For example, one vendor only charged $1,200.00 for the authoring software, but charged a minimum of $8,000 for the use of the management tool. Therefore, the utility of incurring an additional expense to procure a management tool requires additional analysis.

Finally, once the questions surfaced by the aforementioned topics have been resolved, the next step is to develop a working prototype for an entire course offering. The development of this prototype has two requirements. The first task is to gain familiarity of the features offered by the selected authoring and management tools. The second task is to work closely with the cognizant academic department to develop a relevant lesson plan that can be supported by the authoring and management tools.

Because these topics require careful analysis before implementing a workable ATAPMS, they are ideal subjects for further research.

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APPENDIX A. SELECTING AN APPROPRIATE AUTHORING TOOL

There are currently over 90 different authoring tools for designing and implementing a computer based training course. Selecting the most appropriate tool without using a systematic procedure is a difficult task at best. One methodical approach to this task involves a thorough analysis of the user's needs and then locating the product that best matches them.

To assist a user assess his or her needs, most on line learning sources provide a list of questions to help illustrate the features available for authoring tools. To help match the overall needs of the user, the enclosed tables consolidate a comprehensive list of features characteristics available in authoring tools.

There are several resources available through the World Wide Web that provide a listing of tools and their features. For example, there is a website at [http://www.umr.edu/~rhall/research/weblearning/products.html] that lists links to over 20 websites related to authoring tools and products and an additional 10 websites related to the assessment of authoring tools.

Once the user has determined his or her overall need and identified the required features listed on the following tables, the next step is to find the authoring tool that best matches the desired features listed. One site, shown at Figure A-1 and located at [http://www.ctt.bc.ca/landonline/option2.html], allows a user to perform an online evaluation of up to 33 authoring tools within its database. Using this online evaluation tool, the user can select the applicable features and the evaluation tool will display the application name of the authoring tool(s) that most closely match the features indicated.

The other option for this program is to enter the authoring tool name and the evaluation tool will display checkmarks in the corresponding feature boxes.

As an additional resource, an online glossary of terms is available from the same provider at [http://www.ctt.bc.ca/landonline/glossary.html].

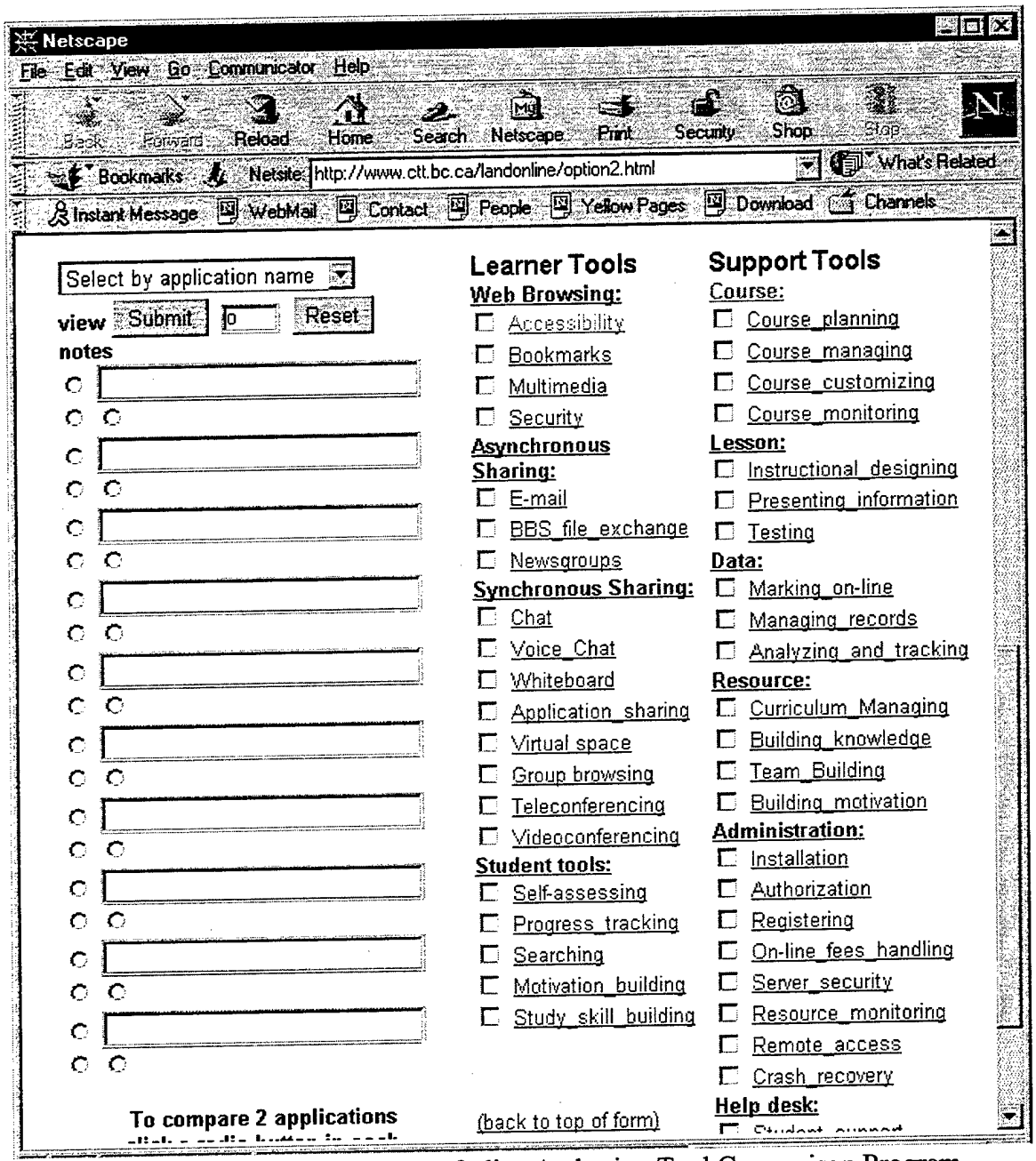

Figure A-1 From [Ref. 46]. An Online Authoring Tool Comparison Program.

After selecting one or more candidate tools, the next step is to contact the vendor and verify the information concerning the advertised features and their actual cost structure. Usually, the vendor employs a sales staff to field the rudimentary questions. However, it is helpful to obtain a contact number to the technical staff for questions that require a more detailed response.

In addition to gathering cost and feature data, testing an online demonstration or obtaining a trial version of the candidate's software is the next important step. Most vendors post an online course that demonstrates the capabilities of its authoring tool. Navigating through the "demo's" offered through the various candidates' websites is an excellent way to compare the each vendor's product. Ultimately, obtaining a trial version of the actual authoring tool is the ideal method for familiarizing oneself with the all the tools features and capabilities.

Listed below is a comprehensive set of questions to help illustrate the features available for authoring tools. These questions are derived from a site [http://multimedia.marshall.edu/cit/webct/compare/comparison.html#develop] that presents a comparison of online course delivery products. However, because the specific products and their versions listed on the site are subject to frequent changes, this appendix presents only the questions listed on the site and not their results.

ADMINISTRATIVE FEATURES
University will have sole ownership of custom code used to create courses
University will have sole ownership of course content
Platform provider will provide technical support to University students
Platform provider will provide technical support to University faculty and staff
Platform provider will host courses on their server
Platform provider will advertise courses
Platform provider can provide documentation and contacts to demonstrate a positive track record with higher education
Pricing structure is based upon number of students within the course
Platform is focused on locally developed courses as opposed to "canned" courses
Platform has large startup cost with minimal continual costs

Table A-1. Administrative Features.

ADMINISTRATOR TOOLS
Server
Client/Web interface
Authorization tools
Logout feature
Resource monitoring
Remote access tools
Crash recovery tools
Student support tools
Instructor support tools
Administrator support tools
Built-in file management tools
Ability to export raw data
Customization of text messages
Resume session function
Security access
Variable level of security
Online registration
Registered markers
Batch process for inputting student accounts
Guest account creation

Table A-2. Administrative Tools.

DEVELOPMENTAL FEATURES
Content format will allow for simple transfer to/from another vendor's platform
Platform uses open data standard so that it can communicate with existing university database applications
Content can be authored on PCs running Windows 95/98/NT
Content can be authored on Macs running OS 7.5 or greater
Courses can be taken using a PC running Windows 95/98/NT
Courses can be taken using a Macintosh running OS 7.5 or greater
Platform provider is supportive of implementing IMS standard within product
Platform provider is supportive of implementing AICC standards within product
Platform utilizes standard HTML for content creation
Platform is structured so students can view all of their current courses when they log on
Platform's server software will run on DEC Unix
Platform's server software will run on Windows NT
Multiple choice questions can be created\scored with platform's authoring software
True\False questions can be created\scored with platform's authoring software
Matching questions can be created\scored with platform's authoring software
Short answer questions can be created\scored with platform's authoring software
Essay questions can be created\scored with platform's authoring software
Platform supports question database for management of test questions
Platforms supports reporting features for test questions
Platform supports Microsoft Internet Explorer 4.x and newer browsers
Platform supports testing stage for courses to debugged before making them live to students
Platform allows author to view course as student without logging out
Platform has built-in threaded discussion list capabilities
Platform has built-in chat capabilities
Platform can be integrated with Real networks video and audio products
Platform can be integrated with Macromedia Shockwave products
Vendor provides development services
Management component will create reports for tracking student progress
Platform has a feature to import existing test questions in a tab-delimited format

Table A-3. Developmental Features.

HARDWARE REQUIREMENTS
UNIX server
NT 4.0 server
CGI-enabled Web server
Java-enabled Web browser
Mac OS
Solaris
Linux

Table A-4. Hardware Requirements

INSTRUCTIONAL FEATURES
Platform choice can be customized to incorporate SPU distinctives
Faculty to student asynchronous communication is possible
Faculty to student synchronous communication is possible
Faculty can make their own changes to content
Training is provided for faculty
Courses can have consistent interface
Platform supplies access to library resources other than the university's present holdings
Online help is available to help student use library resources
Platform includes an internal e-mail client
Platform has e-mail management capabilities for students
Platform has e-mail management capabilities for faculty
Platform supports multiple instructors for a single course

Table A-5. Instructional Features.

INSTRUCTOR TOOLS
Course planning
Course managing
Fast course revising
Course monitoring
Instructional designing
Presenting information
On-line testing
On-line grading
Managing records
No HTML knowledge required
Customization of student curriculum
Student tracking
Automated grading
Level of control over design
Instructor can assign specific course material to individual or group of students
Multiple choice self test tutorial questions - (automatic marking)
"Fill in the blank" self test tutorial questions - (automatic marking)
Customized feedback to tutorial questions
Redirect path of tutorial depending on question answers
Timed quizzes (graded with permanent mark retention)
On line marking and grades management of timed quizzes
Generate random set of questions
Allows developer to preview course as a student

Table A-6. Instructor Tools.

SOFTWARE COSTS
Start-up costs
On-going costs
Site pricing

Table A-7. Software Costs.

STUDENT TOOLS
Authentication
Bookmark management
Multimedia support
Private e-mail
File submissions
Threaded discussions
Course Chat rooms
Logged chat
Whiteboard
Self-assessing
Progress tracking
Desktop based file management for uploading to server
Study skill building
Un-timed quizzes
One question-at-a-time function
Bulletin board/conferencing tools
Image database
Student access to own grades
Access to course grade distribution
Automated glossary tool
Automated index tool
Online assistance
Search tool for course content
Student presentations area
Allows students to view all current courses in which they are registered after logging in

Table A-8. Student Tools.

TECHNICAL SUPPORT
External e-mail
Security features
Assignable administrator role
Batch add instructors
Batch add students
Template creations tools
Built-in instructor manual
Built-in student manual
Database

Table A-9. Technical Support.

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